Early Social Behaviour in Young Children with Autism Spectrum Disorders

by

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Abstract

The current studies addressed two questions regarding early social behaviour in children with Autism Spectrum Disorders (ASD) that have not yet been directly explored. In Study 1 we examined the hypothesis that impaired imitation in this group may reflect a diminished social motivation to engage, rather than a core deficit in imitation. Young children with and without ASD engaged in imitation tasks during which controlled manipulations of reward (social and non-social) were administered for target behaviours. Children with ASD displayed increased levels of imitation with the incentive of an external reward in comparison to when this reward was absent. There was no differential impact of social versus non-social rewards. Typically developing (TD) children performed similarly, irrespective of whether or not reward was administered. We suggest that young children with ASD may be capable of imitating when appropriate incentives are present. Study 2 explored the breadth of social challenges faced in young children with ASD by examining a later-developing domain of social functioning that may be compromised by early social difficulties. We explored the tendency of children with ASD to engage in helping, sharing, and comforting behaviour in situations where the need for the prosocial behaviour was displayed and in perceptually similar situations where the need was absent. Children with ASD displayed low levels of helping and sharing, but provided comfort at levels consistent with TD children. For both comforting and sharing, children with ASD successfully discerned situations where a need was present from when it was not and adjusted their behaviour accordingly. We suggest that children with ASD may require different 'conditions' to engage in social behaviours at the same level as their TD peers and suggest future research to this end.

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Chapter 1 - General Introduction

Autism Spectrum Disorders (ASD) [1] are a group of childhood neuro-developmental disorders characterized by the co-occurrence of impaired communication, impaired reciprocal social interaction, as well as the presence of restrictive, repetitive behaviours and interests (American Psychiatric Association (APA), 2000). Clear characterization of impairments faced very early in development in this population has long been a research focus and is made even more pertinent with the increasing evidence in favour of early detection and intervention (e.g., Harris & Handleman, 2000). Yet factors such as the heterogeneity of symptoms and of outcomes in individuals with an ASD and the fact that diagnosis is often made late (age 3 to 5) make the characterization process complex (Sigman, Spence, & Wang, 2006). The current paper focuses specifically on the early social challenges in young children with ASD with an aim of better understanding 1) why impaired social functioning exists and 2) how far early social impairments extend into later-developing domains of social behaviour.

Impaired social functioning can be observed within the first year of life in children with ASD, who tend to pay reduced attention to others and have been depicted as a socially aloof (Osterling, Dawson, & Munson, 2002; Sigman & Capps, 1997). Both retrospective and prospective studies report a reduced use of their eyes (e.g., poor eye contact, reduced gaze following, reduced joint-attention) and gesture (e.g., poor following of other's pointing, lack of declarative pointing) as a means of social communication (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Maestro et al., 2002; Osterling et

[1] It is now recognized that autism is a spectrum of disorders which includes Autistic Disorder, Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS), and Asperger Syndrome, which are collectively referred to as Autism Spectrum Disorders (ASD) from here on.

al.; Riby & Hancock, 2008; Sigman et al., 1999). Likewise, children with ASD tend to display a restricted range of facial expressions (Robins, Fein, Barton, & Green, 2001) and demonstrate poor integration of verbal and nonverbal aspects of communication (Hobson, 1986a; 1986b). Widely noted deficits related to back-and-forth interaction with others (social reciprocity) include imitation (Williams, Whiten, & Singh, 2004), social responsiveness (e.g., orientation to name and to social stimuli), pretend play, and spontaneous collaborative engagement (Liebel, Colombi, Rogers, Warneken, & Tomasello, 2008).

Social Cognition and Theoretical Accounts

Researchers in ASD have devoted enormous effort to the field of social cognition, therefore, performance in this particular area of social functioning is relatively well understood in this population. Joint-attention and imitation have been examined extensively in children with ASD, with widely-replicated deficits reported in the literature (e.g., Charman et al., 1998). These behaviours facilitate learning (both about the environment and people in it) (Tomasello, 1999) and enable opportunities for communicating and interacting with others (Eckerman & Didow, 1996; Nadel, Guerini, Pezé, & Rivet, 1999); thus, they provide a sense of connectedness with others (Rogers, Hepburn, Stackhouse, & Wehner, 2003). Importantly, they are thought to mark the foundation of theory-of-mind development (understanding that others have perspectives different from one's own) (Baron-Cohen, 1999). The key role that joint-attention and imitation play in development poses concern as deficits in these domains have the potential to fan out to a wide array of later-developing social and cognitive skills. The full extent of their impact on future abilities in individuals with ASD is not yet known.

What remains missing in current understanding of social cognitive impairments in children with ASD is *why* they exist. One possibility is that children with ASD possess an innate lack of responsiveness to social stimuli which gives rise to subsequent social cognitive impairments and reduced inclination to engage socially (Social Cognitive theory) (Baron-Cohen, Leslie, & Frith, 1986). More recently, some researchers have postulated that deficits in social motivation precede, and give rise to, deficits in social cognition, rather than the other way around. That is, individuals with ASD have a primary deficit in social motivation mechanisms which deprive the child of important social learning opportunities, leading to diminished expertise in social cognition (Social Motivation theory) (Chevallier, Kohls, Troiani, Brodkin, & Schutlz, 2012). Questions also surround whether social disinterest reflects an aversion to social interaction, or simply that social interaction is not internally reinforcing (Sigman et al., 2006). Thus, both theoretical accounts would predict similar behavioural presentations that entail impaired social cognition and impaired social motivation, with the primary distinction being that of causality: which deficit preceded the other. Properly understanding which deficits lies at the root of social impairments holds substantial weight for developing appropriate intervention. Specifically, the underlying mechanism would assist in dictating whether training programs should be aimed at teaching skills, at increasing motivation, or possibly both in children who have experienced the secondary effects for sufficiently long that they also require remediation.

Under both theoretical accounts, early impairments in *social orienting* in children with ASD would be expected and are supported empirically. Whereas very early in typical development, a preference is seen for social signals (e.g., human faces and bodies)

(e.g., Gliga, Elsabbagh, Andravizou, & Johnson, 2009), this same priority is not seen in children with ASD. In addition to the clinical characteristics depicted above (e.g., infrequent orientation to name, reduced eye contact, etc.), children with ASD spend more time attending to background than social elements of pictures (Riby & Hancock, 2008) and prefer geometric patterns over social patterns (Pierce, Conant, Hazin, Stoner & Desmond, 2011). While these findings do not discredit either theory, they also do not assist in teasing them apart.

Chevallier et al. (2012) described two further elements of social motivation that, with increased investigation, may shed light on the theoretical underpinnings of social cognitive impairments in children with ASD. In addition to social orienting, these authors suggested that social motivation also entails the tendency to seek out and obtain pleasure in social interaction (*social reward*) and the tendency to attempt to foster and maintain social bonds (*social maintaining*). In terms of *social reward*, TD children prefer collaborative activities over independent ones (Fehr & Camerer, 2007) and their desire to help others is found to decrease with the introduction of a material incentive (Warneken & Tomasello, 2008). Thus, TD children are thought to find social interactions inherently rewarding. *Social maintaining* behaviour is also observed in TD preschoolers who spontaneously engage in positive self-presentation, engage in prosocial lie telling, and conceal negative emotions to be polite (Fu & Lee, 2007). Various impairments in seeking, enjoying, and maintaining social interactions are observed in children with ASD (e.g., reductions in declarative pointing, joint-attention, diminished preference for collaborative activities, reduced social laughter, reduced hiding of emotions) (Dawson et al., 1998; Liebel et al., 2008). Yet, many of these behaviours require a certain level of

social cognitive or emotional understanding, returning to the original question of which impairment precedes the other.

At a biological level, existing research supports the involvement of network of brain regions and neuropeptide signaling on social motivation. The orbitofrontal-striatal-amygdala circuit, influenced by the neuropeptide oxytocin, is found to be implicated in guiding one's attention to social stimuli and in interpreting reward (Klein, Shepherd, & Platt, 2009). In fact, levels of activation of this network are demonstrated to correlate with levels of social orienting (Schirmer et al., 2008). The orbitofrontal-striatal-amygdala circuit is demonstrated to be abnormal in individuals with ASD (Bachevalier & Loveland, 2006), yet investigation of the involvement of oxytocin in this population is in its preliminary stages. Although much more work remains to be done, the evidence in favour of both the behavioural manifestations and biological mechanisms geared at enhancing social participation suggests that social motivation may be innately driven.

Aims of the Current Paper

Unfortunately, the nature of tasks designed to measure social cognition joint-attention and imitation tend to be poorly equipped to disentangle the Social Cognition theory from the Social Motivation theory. Frequently, children with ASD enter into a social context with an experimenter who prompts for target behaviour. A key problem with this methodology is that the tasks and the environmental context are inherently social and require social motivation to engage. Thus, at best this approach can only document impairment and not the mechanism behind it. Recent years have brought about an increased interest in whether a decreased social motivation may be preventing children with ASD from showcasing their full potential. In Study 1, we look to contribute to

remedying this oversight by examining the role of external motivation on imitation performance in young children with and without ASD.

Beyond an improved concept of the underpinnings of social cognition difficulties in children with ASD, is a need for greater understanding of how widely failure to attend to crucial social stimuli in the first few years of life impacts social abilities acquired later in development. Well-established links currently exist between imitation and joint-attention with concurrent and later language abilities (Charman et al., 2003; Sigman et al., 1999; Stone, Ousley, & Littleford, 1997), as well as with their tendency to engage in cooperative activities (Liebel et al., 2008). In Study 2 we examined the propensity of young children with ASD to act in ways that are intended to assist another person in need without gain to oneself (prosocial behaviour), which in typical development is closely linked to joint-attention and imitation (Warneken & Tomasello, 2007).

These studies examined novel questions that sought to contribute to the theoretical understanding of social cognitive impairments in young children with ASD and to expand upon the existing literature by examining domains of social functioning not previously explored. We directly examined the role of social motivation on imitation performance in order to determine whether some of the observed deficits may be accounted for by a diminished motivation to engage with other people. Finally, we sought to assist in capturing the breadth of social challenges faced in young children with ASD by examining later-developing domains of social functioning that may be compromised by early social difficulties. Increased knowledge in these domains will serve to inform appropriate intervention strategies with the aim of promoting positive outcomes in this group of children.

Chapter 2 - Study 1: External Reward Improves Imitation in Young Children with Autism Spectrum Disorders

Imitation fosters the acquisition of new skills and knowledge both about the world (a tool for general learning) and about engaging socially and emotionally with others (a tool for social learning) (Tomasello, 1999; Uzgiris, 1981). TD children access this resource early in development (Carpenter, Nagell, & Tomasello, 1998; Meltzoff, 1995a, 1995b). Four decades of research have documented imitation problems in individuals with ASD, yet why these difficulties exist and whether they reflect a core deficit in autism remain topics of discussion (Rogers & Pennington, 1991; Smith & Bryson, 1994; Vanvuchelen, Roeyers, & De Weerdt, 2011; Williams et al., 2004). Surprisingly, given the diagnostic requirement for impaired social functioning in ASD, few studies have directly explored the prospect that imitation difficulties stem from a broader social deficit. The current study is the first to our knowledge to systematically introduce social and non-social incentives to imitate, so as to directly examine the role of social motivation on imitation in children with ASD.

Imitation in Typical Development

Many forms of imitation are examined in the literature and each provides insight into different aspects of learning. Broad categories include oral-facial imitation, gestural imitation (reproduction of bodily movements and posture), and procedural imitation (reproduction of actions on objects) and seem to be mastered at different stages in development. Reproduction of *oral-facial* and *gestural* positions is observed first in typical development, yet these acts may better represent mimicry than 'true imitation' (reproduction of both the form and intention) (e.g., Anisfield, 1996). However, new born

infants are found to immediately reproduce facial and gestural actions within days of birth (Meltzoff & Moore, 1989) and, at 6 weeks of age, to reproduce mouth opening and tongue protrusions after a 24 hour delay (Meltzoff & Moore, 1994).

Tracing the developmental progression of *procedural* imitation is more complex as the choice of object to be imitated may impact which social learning process is at play. Imitation of a simple action on a familiar object is observed in TD 6-month-old infants (Meltzoff, 1995a). Yet, when using a familiar object, it is unclear whether infants are imitating the observed action or are using the object in a way already established in their repertoire. Imitation tasks employing an unfamiliar object avoid this confound as children do not have prior experience with the object, or knowledge of its function. By 14- to 16-months of age, infants demonstrate the ability to imitate simple actions on novel objects after a four month delay (Barr, Dowden, & Hayne, 1996).

Procedural imitation may also entail reproducing actions on an object in which there is clear goal (goal-directed actions on objects). Such tasks lend insight into whether TD children will reproduce the observed actions (imitation) or will devise their own means to achieve the same goal (emulation). In fact, by 14-months of age, infants were observed to emulate a rational action when a simpler means to achieve the goal was available (Gergely, Bekkering, & Kiraly, 2002). Goal-directed action-on-object tasks are also used to investigate the development of intentional understanding by examining performance in infants who view an experimenter's unsuccessful attempt at achieving a goal. Shortly after their first birthday, TD infants demonstrate the capacity to imitate an experimenter's intended goal (Carpenter et al., 1998). In Meltzoff's (1995b) seminal study, 15-month-olds reproduced the goal equally as often when viewing the

experimenter produce the full action as when the experimenter tried but failed to produce the action.

Imitation in ASD

Broadly, children with ASD tend to imitate less than children with developmental delays who, in turn, tend to imitate less than TD children (Williams et al., 2004), with the most pronounced group differences occurring in young children and lessening with age (Royeurs, Van Oost, & Bothuyne, 1998; Whiten & Brown, 1999). Challenges in neatly characterizing imitation deficits in ASD are due to the breadth in methodology used (i.e., oral-facial, gestural, procedural) and the further division of tasks in meaningful or non-meaningful, single- or multi-stepped, immediate or deferred, and spontaneous or elicited (Williams et al.). As with the TD literature, these tasks variants yield differences in their ability to capture imitation over other forms of social learning (Sevlever & Gillis, 2010).

There is consensus in the literature that widespread challenges are found in individuals with ASD in *gestural* imitation (e.g., Dewey, Cantell, & Crawford, 2007; Smith & Bryson, 1998, 2007), particularly when the gestures carry no semantic meaning (non-meaningful gestures) and thus, there is no obvious goal, affordance, or associated knowledge of the action. The literature on *procedural* imitation is less conclusive with impairments documented in some studies (e.g., Rogers et al., 2003; Stone et al., 1997), but not others (e.g., Aldridge, Stone, Sweeney, & Bower, 2000; Charman & Baron-Cohen, 1994). Yet, procedural imitation that entails a clear goal (goal-directed actions on objects) seems to be spared in children with ASD who tend to perform equally as well as controls (Hobson & Hobson, 2008; Nielsen & Hudry, 2010). Even upon viewing a failed attempt at reaching a goal, children with ASD are found to produce the target action

equally as often as when observing the goal being achieved (Carpenter, Pennington, & Rogers, 2001). Interestingly, when children with ASD observe both the achieved goal and the failed attempt, they are found to reproduce both actions in the same order they were demonstrated (D'Entremont & Yazbek, 2007).

Several explanations are offered to account for imitation impairments in ASD, the most predominant contenders being: a) motor explanations (e.g., bilateral integration, impaired planning and execution of actions) (Rogers et al., 1996; Smith & Bryson, 1998; Vanvuchelen, Roeyers, & DeWeerdt, 2007), b) cognitive explanations (self-other mapping difficulties, the mirror neuron hypothesis, information processing deficits) (Carpenter, Tomasello, & Striano, 2005; Whiten & Brown, 1999; Williams, Whiten, Suddendorf, & Perret, 2001), and c) social explanations (poor social engagement/attention and motivation) (Dawson et al., 1998; Ingersoll, Schreibman, & Tran, 2003). Other factors that may affect imitation in children with ASD include the children's functional level and diagnostic severity (Charman et al., 1998; Stone et al., 1997). The inability of cognitive and motor explanations to sufficiently account for all imitation impairments has been noted and social explanations have also been criticized (Vanvuchelen et al., 2011; Williams et al., 2004). One proposed flaw with the Social Motivation explanation is that if a social disinterest is at the root of imitation impairments, then equally poor performance would be expected across easy and difficult imitation tasks, which is not the case (Williams et al.). Interestingly, this criticism does not take into account other non-social elements of the task (e.g., the toy, the opportunity to learn) that may be motivating to children with ASD.

Most likely, imitation impairments in individuals with ASD reflect a combination of motor, cognitive, and social factors, each contributing in varying degrees depending on personal characteristics and the type of imitation measured. For example, motor abilities may have a greater impact on gestural imitation that requires precise posturing and movement, than procedural imitation. Even so, with the diagnostic requirement of impaired reciprocal social interaction, it is plausible that social motivation may have an overarching impact on a task that is as inherently social as imitation.

The Social Context of Imitation: TD Children

Given the social richness of imitation contexts, it is only fitting that TD children are drawn to participate. In fact, TD infants are less inclined to imitate when the social qualities of the task are removed. TD 14-month-olds demonstrated a decreased tendency to imitate a model's actions on objects if the model was not present to observe them, as compared to when the model was present (Kiraly, 2009). Thus, the absence of a social partner, who represents a source of feedback and correction, may render imitation less desirable to TD infants (Kiraly). Likewise, greater and more accurate levels of imitation were observed in TD toddlers who witnessed a model who was socially engaged, than one who acted disinterested (Nielsen, 2006). TD children are also noted to imitate unnecessary actions, even if doing so results in failure, arguably as a tactic to demonstrate their likeness to others (Nielsen). Thus, the socially rewarding communicative context inherent in imitation tasks seems to be naturally motivating to TD children.

The Social Context of Imitation: Children with ASD

While TD infants may have an intrinsic social drive to imitate others, children with ASD may not be equally motivated by the same social circumstances. Children with

ASD demonstrate less positive affect in joint-attention contexts, compared to TD children (Dawson et al., 1998; Kasari, Sigman, Mundy, & Yirmiya, 1990). The last decade has revealed striking findings regarding a reduced attentiveness of children with ASD to the social subtleties inherent in imitation, and raises the intriguing possibility that this population may perform better if the social requirements of the task are minimized.

Hobson and colleagues (Hobson & Hobson, 2008; Hobson & Lee, 1999) reported on the limited tendency of individuals with ASD to 'identify' with the imitation partner. Whereas young adolescents with ASD successfully reproduced goal-directed actions, they were significantly less likely than their developmentally-delayed peers to imitate the manner in which the model's actions were carried out ('gentle' or 'harsh'). This occurred even when the style of the action was fundamental to the goal itself (Hobson & Hobson). Thus, adolescents with ASD appear to attend more to the action-based elements of imitation tasks than the social elements, perhaps due to assigning priority to instrumental over non-instrumental goals (Bekkering & Wohlschlager, 2000), and/or due to reduced motivation to share in others' experiences (Carpenter, 2006). Whether these findings extend to even younger children with ASD remains unexamined.

The social context in which imitation is measured also impacts performance in children with ASD. McDuffie and colleagues (2007) tested toddlers with ASD for imitation: 1) when directly elicited by an experimenter (i.e., single-step action with object or gesture modelled, with direct request for imitation), 2) in a naturalistic play context (i.e., different actions modelled with toys based on child's play activities, with no request for imitation), and 3) in an instrumental learning context (i.e., modelled objects that produced an activation of lights, with no request for imitation). Significantly less

imitation was observed in the naturalistic spontaneous condition, than when imitation was directly elicited or when it served an instrumental purpose. Moreover, imitation in the naturalistic context was positively associated with levels of social reciprocity (McDuffie et al.). Unfortunately, the variations in the way that imitation was elicited and measured across conditions may have accounted for the observed differences in performance.

Ingersoll (2008) engaged toddlers with ASD in a modified version of McDuffie and colleagues' (2007) study, where children participated in both an elicited imitation and spontaneous imitation condition consisting of the same set of tasks. Toddlers with ASD imitated less in the spontaneous imitation condition than in the directly elicited condition, whereas TD children performed similarly across both (Ingersoll). Even when toddlers with ASD did imitate, they displayed less coordinated joint attention throughout the tasks than did TD children. Ingersoll suggested that toddlers with ASD may have difficulty in determining when to imitate in circumstances where there is no explicit cue, and that this may be broadly linked to reduced motivation to attend to and engage with others.

Reduced replication of a person's style (Hobson & Hobson, 2008; Hobson & Lee, 1999) and reduced imitation for purely social purposes (Ingersoll, 2008; McDuffie et al., 2007) successfully highlight poor engagement of individuals with ASD in the social elements of imitation. Whether these results reflect a lack of social motivation to imitate is merely suggested and was not directly evaluated.

One way of directly exploring the motivational processes on performance is by introducing extrinsic incentives and analysing changes in performance based on these incentives. This approach has been taken in the field of sustained attention and highlights that children with ASD may be especially attuned to, and motivated by, tangible reward.

That is, tangible reinforcement was more efficacious at maintaining careful attention for longer periods of time in children with ASD, than social reinforcement which produced a steeper rate of decline in attention (Garretson, Fein, & Waterhouse, 1990). Similarly, unlike children with Attention Deficit Hyperactivity Disorder who show significant improvements in basic information processing in the presence of social reinforcement, children with ASD did not reap the same benefit (Guertz, Luman, & van Meel, 2008). Whether such reward contingencies would impact imitation in a similar way and in younger ASD populations is unclear.

The only study to directly evaluate the impact of an incentive on imitation in children with ASD was done by Ingersoll and colleagues (2003) who examined the effect of sensory feedback on imitation of actions on objects. Toddlers with and without ASD (matched on mental age) observed actions modelled on three pairs of novel toys. Each toy pair was manipulated in the same way, however, one toy produced a sensory effect (flashing lights and sound) when doing so, whereas the other toy did not. Toddlers were evaluated for their imitation, their social behaviours (social initiations, coordinated joint attention, directing positive affect toward experimenter) and object-oriented behaviours (object engagement, directing positive affect toward an object) during each trial, and toy preference was established during a free play period. Children with ASD demonstrated significantly greater imitation with the sensory toys than with the non-sensory toys, whereas TD children performed equally well across toy types. Children with ASD were also rated as engaging in less social behaviour than the TD children and as having a significant preference for sensory over non-sensory toys. Ingersoll et al. speculated that motivation of children with ASD to imitate may have been enhanced by the sensory

feedback, and that they may have been less reinforced by the social aspect of the interactions compared to the TD children. Nonetheless, better imitation may have resulted from an increased saliency of the goal on sensory tasks, rather than increased motivation. Also, this study did not address whether it was the mere presence of feedback that aided children with ASD, or the specific form of feedback provided (tangible). This study is an important stepping stone and calls for further research that utilizes different forms of feedback that are distinct from the imitation task itself.

The Current Study

Together, the aforementioned studies support the possibility that children with ASD may be unable to exhibit their full imitation potential due to a broad social deficit. If engaging in the inherently social task of imitation is less intrinsically rewarding for children with ASD, it is possible that with appropriate extrinsic motivation, their performance may improve. One form of tangible feedback (sensory) produced increased levels of imitation (Ingersoll et al., 2003), however, no other forms of tangible feedback have been explored. To our knowledge, no direct comparison of the effects of social versus non-social feedback on imitation in young children with ASD has been conducted.

In the current study, children with and without ASD engaged in a series of imitation tasks during which controlled manipulations of reward (social and non-social) were administered for target imitation behaviours. To ensure a manipulation of motivation, rewards were tailored to each child and were selected on the basis that they were known by caregivers to be motivating to their child. Given the evidence supporting a reduced intrinsic social motivation in children with ASD, we hypothesized that the explicit incentive of a tangible reward would increase imitation performance in children with ASD, compared to when this incentive was absent. Theoretically-supported

predictions regarding a differential impact of social versus non-social rewards were not possible given the absence of similar research and especially because both social and non-social rewards were specifically chosen on the basis that they were known to be good incentives. We expected that TD children would demonstrate similar levels of imitation both in the absence and presence of an incentive.

Given the alternate explanations for imitation impairments in children with ASD, careful attention was paid to: 1) motor limitations that may have inhibited performance (tasks entailed actions requiring low level motor skills; exclusion of trials where clear motor restriction was present), 2) intellectual capability to ensure task comprehension (all IQs were greater than 70; exploration of correlations between IQ and performance), and 3) children's attention during individual imitation trials (all tasks were directly elicited imitation tasks to reduce reliance on social attentiveness; all children were coded for distractibility during imitation trials). All tasks examined unfamiliar actions on objects to avoid the confounding factor of individual differences in previously-learned actions. The young age group of participants was selected to facilitate a meaningful comparison with Ingersoll and colleagues (2003).

Method

Participants

Power analyses conducted prior to data collection suggested a sample size of 24.5 per group to detect large effects (d = .80), with power = 0.80, alpha = 0.05, using two-tailed tests. Twenty-three young children with a diagnosis on the Autism Spectrum[2] and

[2] All children had an existing diagnosis of ASD upon participation which was confirmed in the lab using the Autism Diagnostic Observation Schedule (ADOS). As diagnostic stability of an ASD is questionable during the preschool years (e.g., Kleinman et al., 2008) and the ADOS is not effective at differentiating

24 TD children were included in the final sample (see Table 1 for participant sample information). TD children were group-matched on sex and verbal IQ[3] with the ASD participants. Groups differed significantly in both chronological age and mental age, with the TD group being younger than the ASD group on both counts.[4] None of the TD children had medical or developmental diagnoses, nor did they have an immediate family history of ASD. The challenges associated with recruiting very young children with a pre-existing diagnosis of ASD, who were sufficiently high functioning to complete the task, prevented a larger sample size despite significant efforts to do so. Nine additional children with ASD were excluded from the final sample due to failing to confirm an ASD diagnosis using the ADOS (n = 2), IQ falling below 70 (n = 5), and mental age exceeding the upper limit of the selected age range (n = 2). Eight additional TD children were excluded from the final sample due to caregiver interference (e.g., caregiver providing feedback to child for performance during imitation tasks) (n = 3), recording complications (e.g., obstructed view of child's performance) (n = 4) and mental age exceeding the upper limit of the selected age range (n = 1). All participants came from a small city in southeastern Ontario, spoke English as their primary language, and ranged in their SES (approximately one third of families earned less than $65 000, one third earned between $65 000 - $95 000, and one third earned $95 000 and above).

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between diagnoses on the spectrum (e.g., McConachie, LeCouteur, & Honey, 2005), we elected to include children with a diagnosis anywhere on the autism spectrum. According to ADOS scores obtained in the lab, four children with ASD exceeded the cut-off for Autism and 18 children met only the ASD cut-off . One child did not meet criteria on the ADOS, however, exceeded the cut-off criteria on the Autism Diagnostic Interview – Revised (ADI-R), therefore was retained for inclusion in the final sample.

[3] Given the close association between imitation and language, verbal ability is considered to be a highly appropriate matching variable in studies of imitation (e.g., Smith & Bryson, 1994; Stone et al., 1997)

[4] The inclusion of younger TD children not only resulted in the process of matching for Verbal IQ, but was carefully considered. In an unpublished study conducted in our laboratory, baseline levels of imitation in a group of TD preschoolers were artificially low given a diminished interest of the eldest of these children in participating. Younger TD children were selected for the current study to avoid the same pitfall. Importantly, this age difference did not work in favour of the hypotheses.

Table 1

Participant Sample Information

	ASD		TD		
	Mean (SD)	Range	Mean (SD)	Range	Significance, Effect size
Gender	19 males, 4 females		19 males, 5 females		
Chronological Age (in months)	60.17 (9.13)	40 - 71	43.63 (5.07)	36 - 56	$p = 0.00$, $\eta_p^2 = .57$
Mental Age (in months)	55.80 (10.01)	33 - 70	48.94 (7.82)	32 - 68	$p = 0.01$, $\eta_p^2 = .13$
Overall IQ	93.74 (14.03)	73 - 118	112.29 (15.08)	70 -133	$p = 0.00$, $\eta_p^2 = .30$
Verbal IQ	101.61 (14.85)	75 - 143	109.67 (14.04)	81 - 137	$p = 0.06$, $\eta_p^2 = .08$
Nonverbal IQ	91.59 (14.32)	68 - 123	111.88 (17.77)	81 - 148	$p = 0.00$, $\eta_p^2 = .30$
ADOS	10.48 (3.73)	6 - 21	N/A		
SRS Total T-Score	75.70 (13.64)	46 - 90	48.10 (8.60)	39 - 78	$p = 0.00$, $\eta_p^2 = .60$

Note. IQ scores are standard scores; Autism cut-off minimum score of 12, Autism Spectrum Disorder cut-off minimum score of 8 (ADOS Module 2); One participant with ASD whose score fell below the ADOS cut-off was confirmed as being on the spectrum by use of the ADI-R paired with clinical judgement.

Measures

Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2002). The ADOS is a standardized diagnostic instrument used to evaluate and diagnose children on the autism spectrum. All participants with ASD engaged in Module 2 of the ADOS to confirm their existing diagnoses. Three children did not meet the cut-off criteria for an ASD, two of which were excluded from the final sample. For the remaining child (n = 1), clinical judgement deemed a diagnosis of ASD to be likely and the Autism Diagnostic Interview-Revised (ADI-R; Rutter, LeCouteur, & Lord, 2003) was performed with a primary caregiver which confirmed an ASD diagnosis.

Differential Ability Scales – Second Edition (DAS-II; Elliot, 2007). The DAS-II is a standardized cognitive assessment for children aged 2 years, 6 months through to age 17 years 11 months, which includes a battery of subtests that assess nonverbal and verbal abilities.[5] In completing the core subtests, an overall cognitive ability score (IQ) is derived, as well as separate nonverbal and verbal ability scores. All children completed the Early Years Battery core subtests. For children up to age 3 years, 5 months, this entailed four subtests: two verbal ability subtests and two nonverbal ability subtests (including both nonverbal reasoning and spatial abilities). Children aged 3 years, 6 months and above completed six subtests: two verbal ability subtests, two nonverbal reasoning subtests, and two spatial abilities subtests. Importantly, children were required to obtain an overall cognitive ability score of at least 70 for inclusion in the final sample. Thus, to minimize the likelihood of poor imitation performance as being attributable to

[5] The DAS-II was selected based on its user-friendly design with young children, its ability to capture verbal and nonverbal aspects of learning, as well as its ability to be used with the full age range included in the current study.

low cognitive functioning, children whose levels of intelligence fell in the range of Mental Retardation according to the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition – Text Revised (DSM-IV-TR; APA, 2000) were excluded. Children's verbal ability standard score was the measure upon which ASD and TD groups were matched.

Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). The SRS is a parent questionnaire that examines a range of social behaviours and is used to measure autism symptom *severity* in everyday social settings. That is, it provides an indication of the extent of impact of social difficulties on a child's everyday social functioning. The standard version of this form was used and is designed for use with 4- to 18-year-olds[6]. This questionnaire evaluates five categories of social behaviours: social awareness, social cognition, social communication, social motivation, and autistic mannerisms that can be evaluated in isolation or summed into a Total t-score. Total t-scores were generated and provided a continuous measure of sociality of participants.

The imitation tasks entailed the use of twelve familiar objects/toys, twelve ambiguous objects/toys (objects without an obvious affordance or use), and 24 goal-based activities. A large majority of studies examining the development of imitation abilities have targeted infants, rendering pre-existing imitation batteries inappropriate for the current study. Special care was taken by the author and her research team to design a novel battery of imitation tasks that were sufficiently more complex than those used in

[6] A preschool version of this form (for 3-year-olds) has more recently become available. The item content of the standard and preschool version differs only in the developmental appropriateness of the wording for rating behaviours (Pine, Luby, Abbacchi, & Constantino, 2006). Thus, the 3-year-olds included in the current sample (for the purpose of obtaining appropriate verbal IQ matches) were evaluated on the same behaviour as if the preschool form had been given, but were compared to the 4-year-old norms. Importantly, this would likely work to the disadvantage of children below age 4, yet all but one TD child scored within the normal range on the SRS.

previous research and appropriate to the age group of the current study. Tasks were carefully designed with the cognitive abilities, motor abilities, and sensory sensitivities of populations examined here, in mind. Imitation tasks were piloted on a group of children with and without ASD to ensure the absence of floor and ceiling effects.

Procedure and Design

All participants attended the lab twice and were able to familiarize themselves with the environment and the experimenters before beginning testing. On their first visit, children completed half of the DAS-II, followed by three phases of the experimental task (*Baseline phase, Reward Room phase, Testing phase*) (phases to be explained in detail in subsequent sections). Within two weeks of their first visit, children returned to engage in the last phase of the experimental task (*Follow-Up phase)* and to complete the remainder of the DAS-II. Children with ASD also took part in the ADOS at the end of their second visit. The *Follow-Up phase* always occurred immediately at the beginning of the second session. Each session lasted about one hour. The SRS was given to caregivers during the first session and returned on the second visit.

To systematically examine the role of motivation on the tendency of children with and without ASD to engage in procedural imitation, children engaged in a series of imitation tasks entailing controlled manipulations of rewards for engaging in target behaviour. Participants were assigned to receive either a non-social reward (Non-Social Reward condition) or a social reward (Social Reward condition) for successful imitation.[7]

[7] The breakdown of specific rewards assigned was as follows: 100% (n = 12) of TD children assigned to the Non-Social Reward condition received a small edible (Smarties, Skittles, etc.), whereas 81.81% (n = 9) of children with ASD received an edible and 18.18% (n = 2) received a sticker. In the Social Reward condition, 58.33% (n = 7) of TD children received a high-five and the remaining 41.66% (n = 5) of TD children received a form of verbal praise (Excellent!,Good Job! Well Done!, etc.). Similarly, 66.67% (n = 8) of children with ASD in the social condition received a high-five, with 33.33% (n = 4) receiving praise.

Participants were assigned to a condition upon recruitment, through alternation. Eleven children with ASD and 12 TD children took part in the Non-Social Reward condition, whereas 12 children from each group were part of the Social Reward condition.

Children assigned to the Non-Social Reward condition were immediately rewarded with a non-social prize following successful imitation on the individual imitation trials. Children assigned to the Social Reward condition were offered a social 'prize' for each trial in which they imitated the experimenter. No reward was offered in the absence of correct imitation in both conditions. To ensure that children were motivated by their reward, primary caregivers of participants were surveyed prior to testing to determine the most suitable non-social (e.g., stickers, Smarties, Skittles) and social (e.g., "Well done!", “Good job, (name)!”, high-fives) incentives for their child. For each participant, only one reward was selected and was used for the duration of the testing. Only small amounts of reward (e.g., one candy, one high-five) were administered per trial in the Non-Social Reward condition to avoid boredom with, or satiation of (in the case of edibles), the reward. Most children responded positively to their pre-designated reward on the first trial that it was offered to them. For a small portion of children (n = 2), the experimenter deferred to an alternate reward (taken from the caregiver suggestions), given a clear negative response by the child to the initial reward choice. Both children then responded positively to the new choice of reward.

The Non-Social Reward and Social Reward conditions comprised the same experimental task and differed only in terms of the reward provided. The experimental task was divided into four distinct stages and proceeded in the following order: *Baseline phase*, *Reward Room phase*, *Testing phase,* and *Follow-Up phase*.

Baseline phase. The *Baseline phase* served to determine children's baseline levels of imitation prior to introducing the incentive of a reward. Children entered Testing Room 1 and engaged in a set of 16 imitation trials administered by Experimenter 1. A description of the imitation procedure is detailed below.

Reward room phase. Following the *Baseline phase*, children moved into an adjacent testing room (the Reward Room) with a second experimenter (Experimenter 2). The *Reward Room phase* served to highlight to children that, in this room, receipt of a reward was contingent on their imitative performance. That is, successful completion of an imitation task would result in them being rewarded, whereas unsuccessful completion of the task would result in no reward. Upon entering the room, Experimenter 2 told children that in this room a reward would be administered each time they did what they were "supposed to". Children engaged in one easy nonverbal task (completing an infant form board) designed for children to succeed and one difficult nonverbal task (removing the cap from a child-proof bottle to retrieve a paper clip inside) designed for them to fail. Upon completing the easy task, Experimenter 2 gave children their pre-designated reward (e.g., candy, high-five) in addition to verbal reinforcement (Non-Social Reward condition: "See, you did what you were supposed to, so you get a (insert reward)"; Social Reward condition: "See, you did what you were supposed, so I am really happy!"). No children succeeded in performing the difficult task. Following their attempt to perform the difficult task, Experimenter 2 stated, "See, you didn't quite get that right, so this time you do not get a (insert reward)" or "See, you didn't quite get that right, so this time I am not really happy" in the Non-Social Reward and Social Reward conditions, respectively.

The tasks during the *Reward Room phase* shared no resemblance to, and did not reflect skills necessary for engaging in, the imitation tasks.

Testing phase. While remaining in the Reward Room, children then began the *Testing phase.* Experimenter 2 administered a second set of 16 imitation trials, of similar complexity to those used in the *Baseline phase*. Before beginning, children were reminded once that successful performance would result in a reward, whereas unsuccessful performance would not. In the Non-Social Reward condition, Experimenter 2 said, "Remember (Child's name), if you do what you are supposed to then you will get a (insert reward)!" In the Social Reward condition the reminder was "Remember (Child's name), if you do what you are supposed to then I will be really happy!" Participants immediately received their pre-designated reward for each trial that was successfully completed. No reward was offered in the absence of imitation. Thus, failure to imitate correctly resulted in an omission of reward, but no negative consequence (i.e., punishment) was provided otherwise.

Follow-Up phase. Participants took part in the *Follow-Up phase* within about two weeks of their first visit[8]. Children entered the Reward Room and were administered a third set of 16 imitation tasks by Experimenter 2. Importantly, the reward was *not* administered for successful performance during this phase: despite previous assignment to condition and previous experience of being rewarded in that room by that experimenter, children were not offered their pre-designated reward. Thus, this phase resembled the *Baseline phase*. The goal of this phase was to explore whether increased

[8] Two participants from the final sample (both in the ASD group) did not engage in the *Follow-Up phase.*

motivation to imitate on the basis of being rewarded would be sustained after a period of delay or whether the tendency to imitate would decrease once the incentive was removed.

Imitation procedure. The imitation tasks used in the present study entailed immediate, multi-stepped, procedural imitation only and specifically examined: 1) *imitation of actions on objects* and 2) *imitation of goal-directed actions on objects*. During each *Baseline, Testing*, and *Follow-Up phase,* eight action-on-object imitation trials and eight goal-directed action-on-objects imitation trials were administered, totalling to 16 trials per phase. Each phase consisted of a distinct set of imitation trials, such that no trials were used more than once. Across the three phases then, 48 different imitation trials were administered to each child. In all cases, the objects offered minimal sensory output (i.e., no sounds, no lights, no unusual textures), to ensure that increases in performance would not be attributable to sensory feedback (i.e., Ingersoll et al., 2003).

Imitation of Actions on Objects. All children were tested for their ability to imitate *actions on objects* on eight trials per phase (see Table 2 for action-on-object tasks). On four of these trials, the experimenter performed an unusual action with a familiar object, whereas on the remaining four trials, the experimenter demonstrated an unusual action using an ambiguous object. Thus, all actions were non-meaningful. Each action was modelled only once. Correct imitation was considered to have occurred if the child copied the experimenter's actions without adding or omitting any elements, and if the actions were performed in generally the same way (e.g., actions generally looked the same). On each trial, imitation was coded as present or absent.

Table 2

Description of Action-on-Object Imitation Tasks

Familiar Toy		Unfamiliar Toy	
1. Horse figurine:	Toss in air and catch in palms	1. Honey dipper:	Roll in palms
2. Doll bed:	Turn bed upsidedown and tap	2. Playdough roller:	Flip handle over and back
3. Pencil:	Spin on table	3. Thumb wrestler:	Stick thumb up hole and wiggle
4. Elastic band	Trace circle with elastic band on table	4. Artifical leaves:	Fan both sides of face
5. Face cloth:	Twirl in air over head	5. Mini plastic jar:	Hop jar into upsidedown lid and out
6. Rubber duck:	Flip duck head over tail	6. Hairbrush handle:	Peer through hole in handle, look around
7. Motorcycle:	Lay on its side and turn using finger	7. Green stalk:	Sweep across table
8. Eraser:	Move in a 'snakelike' way across table	8. Funnel with pen:	Put pen in funnel and flop back and forth
9. Toucan figurine:	Twist wings around	9. Playdough moulds:	Pinch moulds together (like crab claws)
10. Pez dispenser:	Flick 'legs' backwards	10. Cat pillow:	Push across table
11. Gorilla figurine:	Flip onto back, then onto feet	11. Plastic cushion:	Flip upsidedown, then upright
12. Glue stick:	Roll across table	12. Lanyard:	Drag across table using finger

Imitation of Goal-Directed Actions on Objects. All children were also evaluated for their tendency to imitate *goal-directed actions on objects* on eight trials per phase (see Table 3 for goal-directed action-on-object tasks). That is, the experimenter performed eight distinct trials in which she attempted to achieve an end-state, or goal, through acting upon objects. On four trials she successfully achieved her goal. However, on four trials she tried, but failed, to reach a desired goal. Regardless of the experimenter's outcome, each goal-directed action was modelled only once. On all trials, correct imitation was considered to have occurred if the child achieved the intended goal. Thus, children were considered to have correctly imitated the experimenter if 1) they copied her successful completion of the goal, or 2) they performed the intended goal that the experimenter failed to accomplish. As before, correct imitation was also contingent on the absence of additions, omissions, or differences in general appearance to the experimenter's actions. For each trial, imitation was coded as present or absent.

Across all imitation trials, the experimenter began with "Okay, watch me", followed immediately by a demonstration of the task and a subsequent "Okay?" to signal the end of the action. The experimenter then prompted the child to imitate by saying, "Your turn". Regardless of the correctness of their performance, the experimenter said, "Okay, let's do another one" in a neutral tone, while maintaining a neutral facial expression. Thus, even if a reward was administered (in the case of the *Testing phase*), the experimenter remained entirely neutral otherwise. The experimenter spoke only as outlined by this script. Where other comments were unavoidable, she responded in the most neutral way possible (i.e., if a child asked about what to do, she responded with, "Just do what you think is best").

Table 3

Description of Goal-Directed Action-on-Object Imitation Tasks

	Achieved Intention	Failed Intention
1. Pencil/Tube:	Put pencil in tube and pull out other side	Miss getting pencil in tube
2. Ball/Bucket:	Bounce ball over pencils, drop into bucket	Bounce ball over pencils and miss bucket
3. Large Lego:	Stack four large lego blocks	Fail to stack last lego block
4. Clips/Board:	Attach three large clips to cardboard	Miss board with last clip
5. Dice/Tower:	Drop dice down slide into box	Drop dice, but miss getting it onto slide
6. Peg/Container:	Place peg into container, roll into goalposts	Miss getting in goalposts
7. Beads/Ring:	Pull string of beads through ring in one pull	String gets stuck part way through ring
8. Stones/Holes:	Drop stones into holes of toothbrush holder	Miss getting last stone into hole
9. Pencil/Ring:	Insert pencil through ring, drop ring in basket	Drop ring but miss container
10. Beater/Hole:	Hang plastic disc on hook	Fail to get disc on hook
11. Hook/Car:	Pull car (with hitch) using plastic ring	Miss hook ring onto hitch
12. Egg/Cup:	Place plastic egg into cup, drop egg in tube	Miss dropping egg into tube
13. Foam/Square:	Place four foam strips overtop square outline	Drop last foam strip in wrong spot
14. Hangers/tub:	Slot three door hangers over playdoh tub	Miss on last door hanger
15. Bunnies:	Hang one bendable toy from another	Fail to hang one toy on the other
16. Blocks/Tube:	Stack wooden blocks, put tube over	Knock blocks over with tube
17. Coins/Bank:	Drop three large coins in piggy bank slot	Miss getting last coin in slot
18. Magnet/Board:	Place one magnet in each corner of board	Drop last magnet before reaching corner
19. Paper Clips:	Link three large paper clips together	Fail to link last clip to chain
20. Cord/Disc:	Wrap pliable cord around disc	Fail to wrap cord completely
21. Coat hanger:	Clip down both sides of clothes hanger	Fail to push second clip down
22. Cloth/Object:	Pull fabric through two holes of object	Fail to get fabric through second hole
23. Bands/Hooks:	Stretch two large bands around two hooks	Fail to second band around both hooks
24. Sticker/Box:	Place sticker inside box, put lid on box	Fail to get lid on box

The order of the imitation tasks in each phase rotated through each type (familiar object, ambiguous object, failed intention, achieved intention) until all 16 trials were complete. The order of presentation was counterbalanced across children both in terms of which type of task participants began with and which condition the tasks appeared in.

Coding

Each session was coded by a research assistant who was blind to the purpose and hypotheses of the study. Imitation across trials was coded as previously described. Children were also coded for whether they observed the demonstration, were distracted during the trial, and had a motor difficulty that prevented them from performing the target action. Trials in which children demonstrated a clear motor restriction were excluded from analysis. Given the exclusion of a small number of trials, percentage scores for overall imitation performance were calculated. Importantly, for each trial, the experimenters' demeanor was coded as either neutral or not, to ensure that their interactions with children would not act as a form of social feedback.

A second blind coder coded a subset of the videos (11 videos, 23%) to establish inter-rater reliability. Coding of imitation performance was compared on a trial-by-trial basis and revealed high inter-rater agreement, with coders agreeing on a mean of 90.00% of imitation trials per child (SD = 4.25) (κ = .77). In all cases of disagreement, the primary coder's ratings were used.

Results

Unless otherwise indicated, alpha was set at .05 in all analyses. All analyses are reported with effect sizes (partial eta-squared). There was no effect of the order in which imitation tasks were presented on imitation performance in any phase (Baseline, Testing,

Follow-Up) of the experimental procedure in either ASD or TD group (Fs < 1.66 ps > .20, η_p^2s < .08). All subsequent analyses were thus collapsed across order. There were also no differences across the Social Reward and Non-Social Reward groups in verbal IQ, t (45) = 1.23, p = .22, η_p^2 = .03, or SRS Total t-scores, t (42) = -0.50, p = .62, η_p^2 = .01.

On more than 99% of imitation trials across the three phases children were rated to have observed the experimenter as she demonstrated each trial (M = 99.95% of trials, SD = 0.31) and to have been free from distraction (e.g., no external variable upon which their attention was caught) during their turn with the objects (M = 99.57% of trials, SD = 1.08). The experimenter was coded as remaining neutral during and following children's performance (entirely neutral in the Baseline and Follow-Up phase and neutral beyond administration of the pre-determined reward in the Testing phase) on a mean of 99.35% of imitation trials across phases (SD = 1.46). Trials were not excluded on the basis of the above variables. On average, less than 1% of all imitation trials were excluded due to visible motor restrictions (M = .98%, SD = 1.61, maximum = 6.25%, minimum = 0%).

Baseline Phase

Overall imitation performance during the Baseline phase was examined using a 2 x 2 (Group [ASD, TD] x Reward type [Non-Social, Social])) factorial analysis of variance (ANOVA). There was a trend for a main effect of group, with TD children (M = 41.81%, SD = 18.41) correctly imitating on a somewhat greater percentage of trials overall than children with ASD (M = 31.96, SD = 16.44), F (1, 46) = 3.53, p = .07, η_p^2 = .08. Consistent with expectations, given the absence of manipulation of reward during the Baseline phase, there was no main effect of reward, nor was there a group by reward type

interaction. In light of the absence of an effect of reward type, all subsequent analyses on Baseline imitation performance were collapsed across reward conditions.

To examine whether performance varied across the four subsets of imitation tasks within the imitation battery administered in the Baseline phase, performance was analyzed using a 2 x 4 (Group [ASD, TD] x Imitation Task [Ambiguous Object, Familiar Object, Achieved Intention, Failed Intention]) mixed model repeated measures ANOVA. A significant within-subjects effect of imitation task was obtained, F (1, 45) = 22.71, p = .00, η_p^2 = .34, however the imitation task by group interaction was non-significant. Separate repeated measures ANOVAs were performed for each group to determine where the task differences lay, with post-hoc comparisons using a Bonferroni adjustment for multiple comparisons (with alpha set at .01). Means, standard deviations, and analyses for these comparisons are depicted in Table 4. Broadly speaking, the highest levels of imitation were observed on the achieved intention trials in both TD and ASD children.

Two subsets of imitation tasks within the battery involved an added complexity. In tasks that required reproducing an ambiguous action with a familiar object, children had to perform the observed actions and avoid producing the action typically associated with each object (e.g., spinning a motorcycle on its side rather than pushing it). Both groups of children performed the expected (familiar) action on less than one quarter of the familiar object trials (ASD, M = 16.30%, SD = 16.18; TD, M = 8.33%, SD = 19.03) in the Baseline phase; there was no group difference, t (45) = 1.54, p = .13, η_p^2 = .05.

Table 4

Percentage of Correct Imitation per Subset of Imitation Task

		Group	
		ASD	TD
Phase	Subset of Imitation Task	*M* (*SD*)	*M* (*SD*)
Baseline	Familiar Object	27.17 (24.90)	34.38 (23.09)[b]
	Ambiguous Objects	20.65 (25.73)[a]	37.50 (32.13)[b]
	Failed Intention	30.80 (27.11)	33.33 (25.18)[b]
	Achieved Intention	49.28 (33.89)[a]	62.84 (28.76)[b]
Testing	Familiar Object	34.78 (24.70)[a]	32.29 (28.05)[b]
	Ambiguous Object	27.17 (22.50)[a]	44.10 (31.32)
	Failed Intention	50.72 (34.72)	44.79 (31.25)
	Achieved Intention	57.61 (35.70)[a]	65.28 (25.50)[b]
Follow-Up	Familiar Object	20.24 (20.34)[a]	28.13 (21.25)[b]
	Ambiguous Object	26.19 (24.34)[a]	42.71 (27.07)
	Failed Intention	28.97 (24.10)	38.89 (33.66)
	Achieved Intention	53.17 (31.68)[a]	57.64 (26.68)[b]

[a] Tasks on which significant differences in performance were obtained within the ASD group: Baseline, F (1, 22) = 10.12, p = .004, η_p^2 = .32; Testing, F (1, 22) = 24.83, p = .00, η_p^2 = .53; Follow-Up, F (1, 20) = 23.83, p = .00, η_p^2 = .54.

[b] Tasks on which significant differences in performance were obtained within the TD group: Baseline, F (1, 23) = 12.72, p = .002, η_p^2 = .36; Testing, F (1, 23) = 17.24, p = .00, η_p^2 = .43; Follow-Up, F (1, 23) = 19.40, p = .00, η_p^2 = .46.

The failed intention tasks also posed an added challenge. Accurate performance on tasks in which children observed the experimenter fail to reach her goal required children to produce the experimenter's intended goal and not the failure. On the failed intention trials administered during the Baseline phase, children in both groups sought to produce the experimenter's intended goal approximately two fifths of the time, sought to reproduce the experimenter's failure approximately two fifths of the time, and on the few remaining trials either did something entirely different with the objects or produced both the failure and the intended act (see Table 5 for means and standard deviations). Of note, this categorization of performance does not reflect the quality (or success) of producing the general actions, but reflects the general aim of their actions.

Testing Phase

To determine whether the introduction of a reward impacted the tendency of children with and without ASD to accurately imitate an experimenter's actions, overall imitation performance during the Testing phase was examined using a 2 x 2 (Group [ASD, TD] x Reward type [Non-Social, Social])) factorial ANOVA. In contrast to the trend observed in the Baseline phase, with the introduction of the incentive of a reward, the overall percentage of trials in which children with and without ASD successfully imitated the experimenter was comparable across groups as seen in the absence of a main effect of group, F (1, 46) = 0.84, p = .37, η_p^2 = .02. Likewise, there was no main effect of reward type, F (1, 46) = 2.23, p = .14, η_p^2 = .05, suggesting that imitation performance across groups did not differ as a function of whether the reward was non-social or social in nature. Analyses also indicated the absence of a group by reward-type interaction, F (1, 46) = 1.82, p = .19, η_p^2 = .04; thus, the impact of the different types of reward on

imitation did not differ significantly across the TD and ASD groups. All remaining analyses of Testing phase imitation were collapsed across reward conditions.

To gain insight into the immediacy of the impact of reward on performance, children's performance on the first four imitation trials during the Testing phase was compared to their performance on the last four imitation trials of this phase using a 2 x 2 (Group [ASD, TD] x Imitation Task Placement [First Four Trials, Last Four Trials]) mixed model repeated measures ANOVA. Both the within-subjects effect of imitation task placement and the imitation task placement by group interaction was non-significant, suggesting that there was no significant difference in amounts of imitation observed on the first four trials as compared to the last four trials in either group (ASD, *M* first four trials = 57.61%, *SD* = 24.35, *M* last four trials = 42.39%, *SD* = 27.63; TD, *M* first four trials = 50.00%, *SD* = 20.85, *M* last four trials = 48.96%, *SD* = 17.26).

To examine whether performance varied across the four subsets of imitation tasks within the imitation battery administered in the Testing phase, performance was analyzed using a 2 x 4 (Group [ASD, TD] x Imitation Task [Unfamiliar Object, Familiar Object, Achieved Intention, Failed Intention]) mixed-model repeated measures ANOVA. A significant within-subjects effect of imitation task was obtained, $F(1, 45) = 39.59$, $p = .00$, $\eta_p^2 = .47$; however, the imitation task by group interaction was non-significant. Separate repeated measures ANOVAs were performed for each group, with post-hoc comparisons using a Bonferroni adjustment for multiple comparisons (with alpha set at .01), to determine where the task differences lay (see Table 4 for means, standard deviations, and analyses). As in the Baseline phase, the greatest amounts of imitation for

both groups of children were observed on trials in which children observed the experimenter succeed in achieving a goal-directed action.

Table 5

Children's Actions on Failed Intention Trials

		Group	
		ASD	TD
Phase	Action	*M* (*SD*)	*M* (*SD*)
Baseline	Produce Goal	44.20 (22.11)	41.67 (30.99)
	Reproduce Failure	35.87 (24.80)	44.79 (25.52)
	Produce Goal & Failure	5.43 (12.96)	3.13 (8.45)
	Different Action	13.41(15.23)	10.42 (15.23)
Testing	Produce Goal	61.59 (36.73)	47.92 (32.06)
	Reproduce Failure	23.19 (35.35)	39.58 (34.51)
	Produce Goal & Failure	7.61 (13.97)	3.13 (8.45)
	Different Action	7.61 (11.76)	8.33 (15.92)
Follow-Up	Produce Goal	48.41 (32.77)	49.31 (39.16)
	Reproduce Failure	32.54 (31.72)	37.50 (39.01)
	Produce Goal & Failure	7.14 (17.93)	6.94 (15.86)
	Different Action	11.90 (16.99)	6.25 (11.06)

Note. Means represent percentage of trials that children sought to perform each action.

Again, analyses were conducted to examine specific performance on the familiar object trials, as well as the failed intention tasks during the Testing phase given their

added complexity. Similarly to the Baseline phase, children in both groups performed the expected (familiar) action less than one quarter of the familiar object trials (ASD Group, $M = 13.04\%$, $SD = 19.76$; TD Group, $M = 13.54\%$, $SD = 20.82$) during the Testing phase; there was no group difference, $t\ (45) = -0.08$, $p = .93$, $\eta_p^2 = .00$.

Children's specific actions on the failed intention tasks during the Testing phase was examined and revealed that children with ASD sought to produce the experimenter's intended goal on the majority of the failed intention trials, sought to reproduce the experimenter's failure on approximately one quarter of trials on average, and either did something entirely different or sought to produce both the failed and intended act on the remaining few trials. A similar breakdown was observed in TD children (see Table 5).

Follow-Up Phase

To determine whether children would demonstrate a change in imitation levels following a prior experience of being rewarded for successful imitation, overall imitation performance during the Follow-Up phase was examined using a 2 x 2 (Group [ASD, TD] x Reward type [Non-Social, Social]) factorial ANOVA. There was a main effect of group, indicating that TD children ($M = 41.88\%$ of trials, $SD = 16.44$) exhibited a significantly higher percentage of overall imitation than did children with ASD ($M = 31.99\%$ of trials, $SD = 14.74$), $F\ (1, 44) = 4.22$, $p = .05$, $\eta_p^2 = .09$. As in the Baseline phase, there was no main effect of reward type, which is not surprising given that all children received neutral feedback during the Follow-Up phase. There was no group by reward type interaction. Thus, all remaining analyses were collapsed across reward type conditions.

To gain insight into the immediacy of the impact of the removal of reward on performance, children's performance on the first four imitation trials during the Follow-Up phase was compared to their performance on the last four imitation trials of this phase using a 2 x 2 (Group [ASD, TD] x Imitation Task Placement [First Four Trials, Last Four Trials]) mixed model repeated measures ANOVA. Both the within-subjects effect of imitation task placement and the imitation task placement by group interaction were non-significant, suggesting that both groups displayed similar amounts of imitation in the first four trials as compared to the last four trials (ASD, *M* first four trials = 33.33%, *SD* = 22.82, *M* last four trials = 29.76%, *SD* = 26.95; TD, *M* first four trials = 52.08%, *SD* = 27.50, *M* last four trials = 37.50%, *SD* = 26.58).

To examine whether performance varied across the four subsets of imitation tasks within the imitation battery administered in the Follow-Up phase, performance was analyzed using a 2 x 4 (Group [ASD, TD] x Imitation Task [Unfamiliar Object, Familiar Object, Achieved-Intention, Failed Intention]) mixed model repeated measures ANOVA. A significant within subjects contrast of imitation task was obtained, F (1, 43) = 43.29, p = .00, η_p^2 = .50, however, the imitation task by group interaction was non-significant. Separate repeated measures ANOVAs were performed for each group, with post hoc comparisons using a Bonferroni adjustment for multiple comparisons (with alpha set at .01), to determine where the task differences lay (see Table 4). In keeping with both the Baseline and Testing phases, the highest levels of imitation were observed on the achieved intention trials in both TD and ASD children.

Again, analyses were conducted to examine specific performance on the familiar object trials and failed intention trials during Follow-Up. Consistent with the Baseline

and Testing phases, children in both groups performed the expected (familiar) action on less than one quarter of the familiar object trials (ASD Group, M = 15.48%, SD = 20.12; TD Group, M = 14.58%, SD = 19.39) during the Follow-Up phase; there was no group difference, t (43) = 0.15, p = .88, η_p^2= .00.

Children's specific actions on the failed intention tasks during the Follow-Up phase were comparable to those observed in both the Baseline and Testing phases (see Table 5). In both groups, children sought to produce the experimenter's goal on about half of the trials on average, sought to reproduce the failure on about one third of trials on average, and on the remaining trials either did something entirely different or produced both the failure and the intended act.

To capture whether children were aware of the removal of the reward during the Follow-Up phase, all comments relating to being rewarded for imitating were recorded. Approximately half of the children with ASD (n = 5) in the Non-Social Reward condition commented on the absence of their reward (i.e., "Aren't you forgetting my skittle?", "I'm going to watch you and copy what you do so I get a prize"). Only two children in the TD group assigned to the Non-Social Reward condition mentioned the absence of reward (i.e., "Did you waste all of your candies, probably?"). One child with ASD assigned to the Social Reward condition verbally indicated the lack of feedback during Follow-Up, where as no TD in this condition did so. All comments occurred in the first half of the Follow-Up phase imitation trials (M = 5th trial, SD = 1.20 trials).

Across-Phase Comparisons

Overall imitation performance was compared across the three experimental phases (Baseline, Testing, Follow-Up) using repeated measures ANOVAs for each group.

Analyses were collapsed across reward conditions given the absence of significant differences in performance based on reward type (non-social and social) in both groups.

TD children demonstrated similar levels of overall imitation across the phases: there were no significant differences observed between Baseline, Testing, or Follow-Up, F (1, 23) = 0.00, p = .98, η_p^2 = .00. Given the small rate of attrition in participants with ASD from Baseline to Follow-up, thus unequal sample sizes, a pairwise comparison was first performed to examine differences in percentage of correct imitation between the Baseline and Testing phases. Following explicit introduction of an incentive (Testing phase), children with ASD demonstrated significantly greater levels of imitation than observed at Baseline, t (22) = -3.00, p = .007, η_p^2= .29. A similar discrepancy was noted upon comparing imitation performance between the Testing and Follow-Up phases, with significantly greater imitation in the former than in the latter, t (20) = 3.24, p = .004, η_p^2= .35. There were no differences in performance across the Baseline and Follow-Up phase in children with ASD, t (20) = 0.01, p = .99, η_p^2= .00 (see Figure 1).

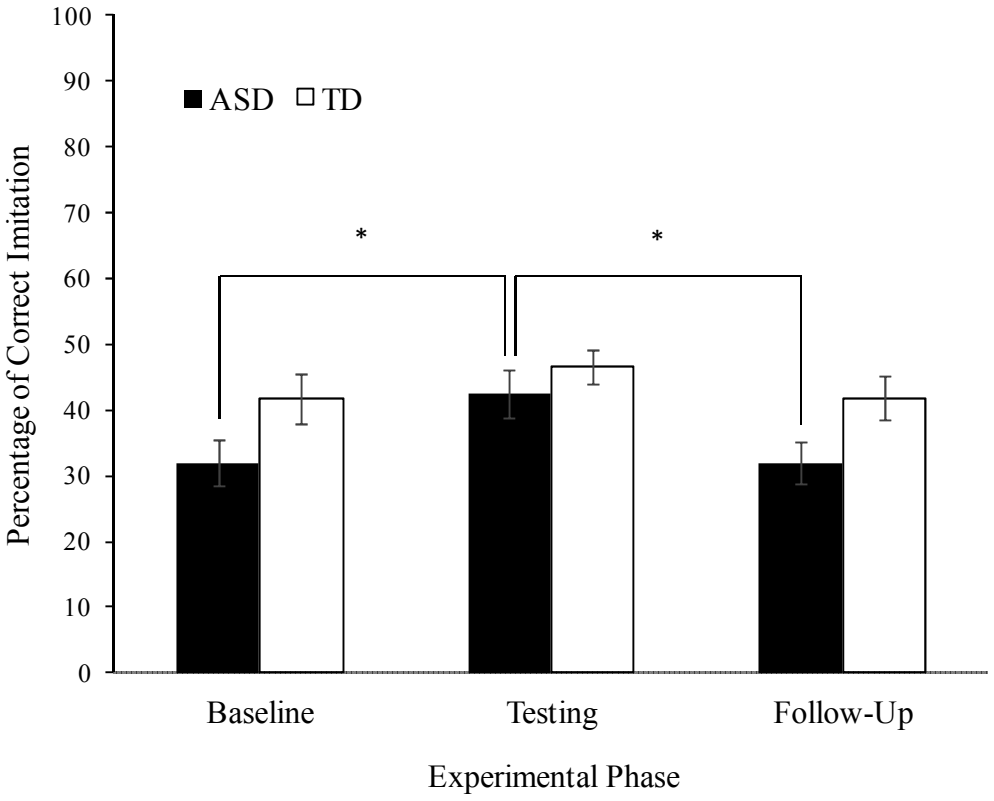

Figure 1. Imitation Performance Across Experimental Phases

Correlations

A series of Spearman correlations were performed to examine possible associations between imitation performance, age (chronological and mental), level of intelligence, and social responsiveness. There were no significant associations between social responsiveness (SRS Total t-score) with imitation performance in each the Baseline, Testing, or Follow-Up phase in either group of children. Mental age and verbal IQ (DAS-II Standard Score) were each significantly positively associated with Testing phase imitation performance in children with ASD ($r = .43$, $p = .04$, $r = .47$, $p = .02$, respectively), but these associations were not seen in the Baseline or Follow-Up phase.

Chronological age was not associated with imitation performance in any phase in the ASD group. On the other hand, neither mental age nor verbal IQ was associated with imitation performance in any phase in the TD group, but chronological age was significantly positively associated with imitation performance in the Testing phase (r = .42, p = .04).

Discussion

The current study systematically examined the role of motivation on the tendency of young children with ASD to imitate actions on objects (procedural imitation). Children with ASD displayed significantly more imitation when there was an explicit incentive to perform correctly (Testing phase), as compared to when no incentive was offered (Baseline and Follow-Up phases). In contrast, TD children performed relatively consistently regardless of the presence or absence of incentive. Only when an incentive was present did children with ASD imitate at a level in keeping with TD children. Like Ingersoll et al. (2003), these findings highlight that young children with ASD improve in their procedural imitation performance when an enticing pay-off is made available.

The Nature of Incentives

The fact that there was no differential impact of non-social versus social rewards on levels of imitation observed in either group of children is of interest. To our knowledge, the current study is the first to specifically contrast the effect of these opposing-natured rewards on imitation performance in this population. Tangible sensory feedback (e.g., flashing lights) was previously found to produce greater levels of imitation in a group of toddlers with ASD than when this feedback was absent (Ingersoll et al., 2003). On the other hand, the implicit social gains naturally afforded in imitation

contexts (e.g., social interaction, social learning) do not generally appear to facilitate imitation in children with ASD (Williams et al., 2004). This paired with the findings that non-social rewards enhance performance to a greater degree than social rewards on other types of tasks in adolescents with ASD, supports the speculation that non-social rewards may be the more effective option for improving imitation (Garreston et al., 1990; Guertz et al., 2008).

One key step in methodology may explain why children with ASD in the current study benefitted equally from social and non-social rewards. All rewards (social and non-social) were tailored to each child and were determined by asking caregivers what was known to be most motivating to their child. Thus, even the social rewards were selected on the basis that caregivers had previously experienced those actions/remarks as being a strong motivator for their child. Inherent in this, any potential gap between preferences for a social or non-social incentive was narrowed. For the majority of children with and without ASD in the Social Reward condition, a high-five was their designated reward (66.67% of children with ASD, 58.33% of TD children). It is important to highlight the tangible quality of high-fives, despite being categorized as "social". Due to small sample size, examination of differences in performance as a function of the specific type of reward was not feasible. It is possible that with greater tangibility, thus saliency, of rewards, imitation is more enticing to children with ASD. Finally, the sample of children selected for the current study were relatively high functioning (mean verbal IQ in the Average range; exclusion of those with IQ's below 70) which may have increased the likelihood of response to social rewards. It is possible that lower functioning children with ASD, who are more impaired in their ability to

attend to social information, might demonstrate greater response to non-social than social incentives.

Implications for the Social Motivation Explanation

The present study clearly demonstrates an improvement in imitation from baseline to when a reward is introduced and a subsequent decrease in performance with the removal of this incentive in young children with ASD, in contrast to the lack of change across conditions for the TD group. Can these findings be interpreted as direct support for the Social Motivation explanation for impaired imitation in individuals with ASD? Careful measures were exercised to control for other factors thought to contribute to imitation impairments in this group. Motor coordination abilities were not evaluated in our participants, however, all tasks entailed low level motor skills and trials on which performance was inhibited due to a clear motor difficulty were eliminated from analyses. Very few trials were excluded on this count, suggesting that the tasks had feasible motor requirements for the age group selected. None of our tasks evaluated gestural imitation on which motor difficulties might be more likely to inhibit performance. Of note, no children in the current study had a diagnosed motor disorder and only a small number of children with ASD (4 out of 23) were reportedly receiving regular Occupational Therapy services (for which the specific reason for services was unknown to us). Although we do not attempt to suggest that motor functioning is not implicated in imitation, we propose that the differences in imitation noted between groups and across conditions in the present study were not driven by motor difficulties.

The design of the current study does not permit much discussion surrounding the proposed cognitive explanations for imitation impairments (e.g., mirror neurons, self-

other reversals) as the tasks did not measure these functions specifically. However, participants were not penalized for reversal errors, thus reducing the impact of self-other mapping challenges on performance. Groups were matched on verbal IQ and neither age (chronological or mental) nor level of verbal functioning was found to consistently relate to imitation performance across groups or phases. Positive associations between both mental age and verbal IQ with imitation in children with ASD were observed only in the Testing phase, indicating this may be tapping sensitivity to reward rather than imitation ability. Levels of social responsiveness were also found to be unassociated with imitation in either group. Nonetheless, the relatively small sample size may have restricted our ability to capture the above effects.

What the current findings appear to demonstrate is that when young children with ASD have a clear-cut incentive to work toward in imitation contexts, they seem to perform better. In contrast, the introduction of a reward did not alter the imitation performance of TD children at all. What is harder to identify is whether the effect of the incentive was that it motivated children with ASD to do something they were not otherwise interested in, or whether its utility was in drawing their attention to the task expectations, or purpose. As previous research demonstrated that structured elicited imitation tasks generate more imitation in children with ASD than naturalistic spontaneous imitation tasks (Ingersoll, 2008), it is possible an extrinsic reward provided additional clarity as to what must be done. That said, reward in the current study was merely introduced as being contingent on "doing what you are supposed to", with no additional instruction of what that consisted of. There was also no significant improvement in imitation over the course of the Testing phase (i.e.., no difference

between performance on tasks at the start and at the end of the imitation battery). Thus, neither task instructions, nor children's performance were suggestive of learning having occurred. The fact that our task did not appear to 'teach' children to imitate suggests that the knowledge base was pre-existing, but that a reason to imitate was needed. Even more, commentary of children with ASD during the Follow-Up phase suggested their acute awareness of the absence of reward, as well as their understanding that receipt of reward was contingent on successful performance. That is, task expectations were known, yet imitation performance quickly dropped (i.e., similar amounts of imitation in the first four trials as compared to the last four trials in the Follow-Up phase) to levels comparable with the Baseline phase when the notion of reward had not yet been introduced.

We alert readers to the possibility that the decline in performance observed during the Follow-Up phase in the ASD group may have been a by-product of previous receipt of reward for success. Mueller and Dweck (1998) found that upon previously receiving feedback on ability, fifth-graders who later faced achievement setbacks displayed lower levels of task persistence, task enjoyment, and performance. It is possible that failure to receive the reward during feedback was especially discouraging to children with ASD and triggered a decline in performance. Nonetheless, their commentary reflected the lack of reward and not their low level of ability, unlike the fifth-graders who attributed low performance to low ability (Mueller & Dweck). Whether this pattern of behaviour applies to children as young as those in the current study and why there was no parallel decline in the TD children who were exposed to the same reward contingencies is unknown.

Performance of TD children may also offer a unique perspective of the role of motivation in the present study. Namely, the required neutrality of the experimenter during the Baseline phase may have rendered imitation less enticing for TD children, who often outperform children with ASD. We highlight the role of our small sample size in detecting effects as well as the young age of our TD group, but pose that the unresponsiveness of the experimenter may have created a socially-awkward environment for TD children who sought to use the interaction as an opportunity for social exchange. Like Nielson (2006), the removal of the social elements of the imitation context may, to some extent, have reduced the appeal of imitating and contributed their reduced imitation.

Imitation Performance in Relation to Existing Literature

Existing studies on procedural imitation in children with ASD have produced varying results, largely due to inconsistencies in how imitation is measured. The current study examined elicited, immediate imitation of non-meaningful actions on objects, as well as goal-directed actions on objects that the experimenter either achieved or failed. We found that children with ASD displayed the highest levels of imitation on tasks that entailed a clear end state (or goal) *and* where they observed the experimenter accomplish this goal. Most strikingly, this pattern was observed irrespective of whether a reward was administered. This supports and extends previous research that finds imitation of goal-directed actions on objects to be spared in children with ASD, who perform equally as well as their TD and developmentally delayed peers in such tasks (Hobson & Hobson, 2008; Nielsen & Hudry, 2010). Like Carpenter et al. (2001), there were no significant differences across the achieved intention and failed intention trials on the tendency of children with ASD to produce the target action. We do not attempt to tackle the question

of the amount of intentional understanding behind their performance, but reinforce that children with ASD appear oriented toward goals (i.e., D'Entremont & Yasbek, 2007).

Rogers and colleagues (2003) suggested that the tendency of children with ASD to act as apprentices in imitation contexts remains intact. That is, children with ASD are motivated to attend to others' actions to learn how objects work. It is possible that this knowledge acquisition (and the satisfaction of achieving the goal) is a form of external feedback. The pairing of this and the fact that some studies entailing goal-directed actions include a 'built-in' reward (e.g., open a box to find a toy; Nielsen & Hudry, 2010), provides insight into why children with ASD do so well on goal-directed tasks.

Overall levels of imitation in the current study were fairly low, even in the TD group. Nonetheless, our findings seem to fit within the range of imitation observed in similarly aged groups in previous studies, which varies from correct imitation on more than half of the trials (Ingersoll et al., 2003) to on only one quarter of trials (Carpenter et al., 2001). Tasks in the current study were designed specifically for the age group examined and each entailed more than one step, which contrasts with many previous studies that involve single step actions. It is possible that the multi-stepped tasks proved more challenging for children. Importantly, however, there were no floor effects. We also employed fairly strict coding criteria in which any addition or omission rendered the behaviour as incorrect.

Other challenges, beyond the number of steps involved in the imitation tasks, were also considered. Our results eliminate the likelihood that difficulties on familiar object trials (where children had to produce a novel action rather than the action typically associated with that object), contributed to the somewhat low levels of imitation. Across

both groups and all phases, children performed the familiar action with the object on less than one quarter of trials. This contrasts with previous studies that have found children with ASD to use the object for its proper use and not the way it was seen, but may relate to the younger age of our sample (Hammes & Langdell, 1981). With respect to the failed intention trials, of concern was if in the Testing phase children perceived reproducing the failure as "doing what they were supposed to do", they may have been confused when they did not receive a reward, and subsequently less inclined to imitate. While this remains possible, several findings would suggest otherwise, namely, 1) children with ASD seemed to perform better on the failed intention tasks during the Testing phase as compared to during Baseline, 2) during the Testing phase children sought to produce the target action on at least half, if not more, of the failed intention trials, and 3) performance on the failed intention trails across all phases was consistent with previous research.

Limitations and Future Directions

The current study provides a preliminary examination of the impact of external reward on imitation in children with ASD and calls for future research to explore those questions that we were unable to address. Significant effects were obtained despite the relatively small sample size, yet we likely lacked power to detect other, more subtle effects. A larger sample size would also afford opportunities to perform additional analyses that could shed light on the motivational explanation. A further limitation lies in the fact that our matching variable (verbal IQ) was slightly higher in the TD group than in the ASD group. Of importance, this difference was not statistically significant, its effect size was very small, and clinically, the mean verbal IQ for both groups was in the average range and fell within half a standard deviation of one another. While the current study

included only children with IQs over 70, inclusion of a control group of children with mental retardation may offer interesting insights into the role of incentives on performance. Given a pre-existing complexity in understanding procedural imitation in children with ASD, future research may wish to use the current paradigm with only one type of procedural imitation task to allow for an in-depth analysis. Caution must also be exercised in generalizing the current findings to tasks of deferred imitation and of imitation of meaningful actions. Finally, future studies may wish to examine the impact of reward on gestural imitation, where a widespread consensus of impairment in children with ASD exists.

Given the developmental functions that imitation serve, the importance of understanding the mechanisms behind imitation impairments in children with ASD cannot be understated. The direct study of the role of motivation on imitation in children with ASD is relatively new, however, accumulating evidence exists in support of a reduced attentiveness to the social elements of imitation tasks, as well as an increased attention to goal-directed aspects in this population. The current study took a novel direction in examining how impaired social motivation may be implicated in imitation impairments observed in young children with ASD. We observed significant improvement in imitation with the introduction of a reward, with no differential effect of social versus non-social rewards. These preliminary findings only touch the surface of the role of social motivation and provide a foundation for future exploration.

Chapter 3 - Study 2: Helping, Sharing, and Comforting in Young Children with Autism Spectrum Disorders

Prosocial behaviour, acting intentionally on behalf of others, is essential for effective social interaction (e.g., Eisenberg, Fabes, & Spinrad, 2006). Some have claimed that humans possess a unique, species-specific psychology that supports the propensity to act on another's behalf (Fehr & Fischbacher, 2003; Silk et al., 2005; Tomasello, 2009). Importantly, given the tendency of children with ASD to show marked deficits in various domains of social and emotional cognition (e.g., Charman et al., 1998), the extent to which they show unique trajectories of prosocial behaviour remains an open question.

There is a growing research interest in understanding the ontogeny of prosocial behaviour. Different theoretical accounts exist regarding its underlying mechanisms in typical development, spanning from the presence of innate biological mechanisms (Tomasello, 2009), to having basic imitative and affiliative tendencies (Hay & Cook, 2007), to having the finesse to distinguish others' internal states from one's own and use both perspectives to act on the others' behalf (Moore, 2007). Despite their differences, these theories appear to share a commonality: in order to act prosocially children must 1) have some recognition of what is required by social partners *and* 2) must be motivated to act on a person's behalf. Theoretically then, the knowledge of a person's need alone is insufficient to produce prosocial behaviour if the desire and ability to *use* that knowledge is absent (Liebal et al., 2008). Perhaps one of the largest obstacles in accurately understanding the construct of 'prosocial behaviour' is that the skills required to recognize the various types of need and identify a fitting response may not be equal across all subtypes of prosocial behaviour, such as helping, sharing, and comforting

(Dunfield, Kuhlmeier, O'Connell, & Kelley, 2011). Yet, the literature has treated prosocial behaviour both as a homogenous family of actions and as individual behaviors.

Dunfield and her colleagues (Dunfield et al., 2011; Dunfield & Kuhlmeier, in press) have recently presented evidence for differences in both the age of onset and developmental trajectories of three different forms of prosocial behaviour, specifically: helping, sharing, and comforting. Helping behaviour entails acting to fulfill another person's *instrumental* need (e.g., retrieving a dropped object for someone; Dunfield et al.). To do this, a child must not only have the capacity to identify another's goal, an ability present before the first birthday (Kiraly, Jovanovic, Prinz, Aschersleben, & Gergely, 2003; Luo & Baillargeon, 2005; Woodward, 1998), but also the ability to recognize the unfulfilled goals of another, which appears around age 18 months (Bellagamba & Tomasello, 1999; Meltzoff, 1995b). TD infants demonstrate a robust ability to provide help in a variety of contexts (e.g., helping an adult retrieve an out-of-reach object, pointing to help an adult find a lost object) by 18 months of age (Dunfield et al; Liskowski, Carpenter, Striano, & Tomasello, 2006; Warneken & Tomasello, 2006; 2007).

Sharing behaviour entails responding to another's *material* need (e.g., sharing a snack with someone who has none; Dunfield et al., 2011). The unique challenges involved in sharing are twofold: a child must recognize the inequality in resources between oneself and another and must also be willing to part with some of his/her own resources (e.g., Brownell, Svetlova, & Nichols, 2009; Thompson, Barresi, & Moore, 1997). Like helping, sharing can be present by age 18 months (Dunfield et al.) and can be observed even earlier when the resource of interest is a non-valued item by the infant

(e.g., *not* a favourite toy; Eisenberg, 1992; Tomasello, 2009) or when oriented to task expectations via a game of give-and-take (Hay & Murray, 1982). The use of the term 'sharing' here is restricted to the willingness to relinquish control over a desired tangible resource, and differs considerably from sharing of non-material resources (e.g., ideas, advice, enjoyment), or instances when the resource is used by another without giving up control.

Comforting behaviour involves acting with the intent to alleviate another's *emotional* need (e.g., supporting someone who is upset; Dunfield et al., 2011). This skill is based on the ability to detect and interpret another's negative emotional state and to determine a response that will alleviate the distress of that specific individual (Bacon, Fein, Morris, Waterhouse, & Allen, 1998; Hoffman, 1982; Rieffe, Ketelaar, & Wiefferink, 2010). The complexity of comforting is amplified by the variety of responses to choose from (Eisenberg, Shea, Carlo, & Knight, 1991) and that one response may alleviate distress differently for different individuals (Rieffe et al.). Thus, comforting is thought to benefit from increased social cognitive maturity (Hoffman, 1982, 2000), as well as familiarity with the person in need (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). Given these challenges, comforting behaviors are slower to develop than helping and sharing. TD infants demonstrate a rudimentary recognition of others' emotional distress around age 2 (e.g., self-soothing behaviour; Zahn-Waxler et al.), but the act of comforting with the intent to alleviate the distress of another does not emerge until after the two-year mark (Rieffe et al.; Dunfield & Kuhlmeier, in press).

Despite the recent advances in understanding the typical development of prosocial behaviour, little is known about how these behaviors manifest in children with ASD.

Existing knowledge of the areas of social challenge present in this population poses two sizable concerns. First, the ability to recognize and understand others' mental states (theory of mind) and emotional states (affect recognition) develops differently in children with ASD (Charman et al., 1998; Dyck, Ferguson, & Shochet, 2001). Second, children with ASD tend to be less attentive to social partners and appear to receive less inherent reinforcement from engaging in shared interactions (Dawson et al., 2004). The combination of impaired mental state understanding and apparent reduced motivation to interact with others may leave children with ASD at a disadvantage to develop prosocial abilities, which are theorized to be inherently founded on these factors.

Empirical studies of the development of prosocial behaviour in children with ASD are scant and, as with the TD literature, are muddied by the inconsistent treatment of prosocial behaviour as independent behaviours versus a unified whole. In an examination of instrumental helping and cooperation, Liebal and colleagues (2008) found that preschoolers with ASD[9], provided aid in simple situations, and they showed some skills in more complex cooperative activities[10]. On two trials, preschoolers with ASD were tested for their ability to retrieve an object that an experimenter was unable to reach (e.g., a dropped pen/hat). Two control trials were also presented, during which another object was out of reach, but this time the experimenter did not exhibit any need for the object. The ASD group helped more often when the need was present, as compared to absent,

[9] One child in their ASD group met the ADOS cut-off criteria for ASD, where as all other participants met the Autism cut-off. The mean IQ score for this group fell within the borderline range of intelligence (Liebal et al.).

[10] Cooperation entails coordinated interactions between two, or more, individuals to achieve a shared goal, and is argued to require more advanced intentional understanding and perspective taking than the aforementioned prosocial behaviour (Bratman, 1992, Tomasello, 2009; Tomasello, Carpenter, Behne, & Moll, 2005), and its foundations are possibly based in prosocial behaviour (Stevens & Hauser, 2004). For these reasons, cooperation is considered by the current authors to be distinct from prosocial behaviour as defined here.

suggesting that they understood the important role that need plays in driving prosocial behaviour. Nonetheless, they were somewhat less adept at helping than their developmentally delayed counterparts of similar intellectual ability, only helping about 50% of the time as compared to about 85% of the time, respectively. In another study, Travis, Sigman, and Ruskin (2001) examined school-aged children with ASD and those with developmental delay on a series of behavioral tasks, including measures of helping and sharing. Specifically, during a refreshment break, children had two opportunities to help the experimenter (i.e., to help to clear a table, to mop up a spilled drink) and share with the experimenter (i.e., to share a snack, to show photos). Scores on all four tasks were combined into one prosocial behaviour score and revealed that school-aged children with ASD produced fewer prosocial behaviors than the developmentally delayed group (Travis et al.). Importantly, this study did not involve control trials, thus the motivation behind children's responses is unclear (e.g., responding to need, for fun, to seek adult approval). Likewise, the reported results do not allow for separate consideration of each helping and sharing, which may develop independently, thus may have occurred in different amounts. Moreover, these findings speak less to the developmental presentation of prosocial behaviour given the older age of the participants.

The closest that research has come to examining comforting tendencies in children with ASD lies in the field of empathy, which entails the ability to feel what another person is feeling and arguably includes both cognitive (attributing a mental state to another) and affective (experiencing an emotion elicited by another's emotion) components (Davis, 1994). Given this definition, it is not surprising that empathic responding in populations with ASD appears to be impaired (Baron-Cohen &

Wheelwright, 2004). That is, individuals with ASD have difficulty labelling their own, and others', emotions (affect recognition) (Dyck et al., 2001; Yirmiya, Sigman, Kasari, & Mundy, 1992) and studies examining the looking behaviour, degree of concern, and/or facial affect of children with ASD in response to another's observed or anticipated distress (e.g., Corona, Dissanayake, Arbelle, Wellington, & Sigman, 1998; Hobson, Harris, Garcia-Perez, & Hobson, 2009; Sigman, Kasari, Kwon, & Yirmiya., 1992), have yielded equivocal findings. Nonetheless, given the evidence supporting the unique development of each variety of prosocial behaviour in TD children (Dunfield et al., 2011; Dunfield & Kuhlmeier, in press), what we know of helping and empathic behaviour in young children with ASD may not necessarily equate their performance on the specific prosocial task of *acting to alleviate another's distress* (the provision of comfort).

The Current Study

To our knowledge, no study has explicitly examined the role of need in motivating the production of three diverse prosocial behaviors (helping, sharing, and comforting) in young children with ASD. The current study looked to extend existing research on prosocial behaviour in children with ASD by addressing two fundamental questions that remain unexplored: (1) Compared to their TD peers at a comparable level of development, how do young children with ASD perform on three prosocial tasks that require the recognition of different kinds of need (helping, sharing, and comforting), and (2) are children with ASD adept at distinguishing situations in which an adult needs assistance from perceptually similar situations in which the need is absent? The age of participants in the current study was selected for two primary purposes: (1) to capture the developmental presentation of prosocial behaviour in children with ASD, without

preceding the age at which these behaviours emerge in typical development, and (2) to facilitate a meaningful comparison with Liebal et al. (2008), whose participants ranged from approximately 2 to 5 years of age.

If children with ASD acquire prosocial behaviour in the same manner as TD children, one may predict that this group will be more adept at helping and sharing than comforting. Yet, different prosocial behaviors require different understanding of other's mental states (e.g., recognizing basic instrumental needs versus complex emotional states), as well as different costs for engaging in the behaviour, and it is unclear whether these factors impact children with ASD differently from their TD counterparts. Given the scarce available literature in prosocial behaviour with ASD populations, there are insufficient grounds to make scientifically-substantiated predictions regarding differences in their performance across the three forms of prosocial behaviour. That said, we expect that children with ASD will exhibit some appropriate prosocial behaviour (e.g., helping, Liebal et al., 2008), but that TD children will engage in more prosocial behaviour than children with ASD on all measures. Moreover, given the tendency of children with ASD to generally be less attentive to others (Dawson et al., 2004) we do not anticipate prosocial behaviour during trials where a need is absent.

Method

Participants

Power analyses conducted prior to data collection suggested a sample size of 15 per group to detect large effects (d = .80), with power = 0.60, alpha = 0.05, using two-tailed tests. Fourteen young children with a diagnosis on the autism spectrum[11] and 14

[11] All children had an existing diagnosis of ASD upon participation, and diagnoses were then confirmed in the lab using the ADOS. Given that diagnostic stability of an ASD is questionable during the preschool

TD children were included in the final sample (see Table 1 for participant sample information). Given that in clinical samples chronological age may not accurately reflect one's developmental level, the TD and ASD groups were matched on mental age as this was thought to create groups that were more closely matched in their level of functioning.

Nonverbal mental age (an indicator of nonverbal IQ) was considered the best matching variable, as all prosocial tasks entailed minimal verbal output. Moreover, it has been argued that matching children on verbal mental age may have underestimated abilities in some tasks (Burack, Iarroci, Bowler, & Mottron, 2002). Rigorous matching criteria were applied in that TD children were 1) individually matched on nonverbal mental age with the ASD participants and 2) the nonverbal mental age of each TD child fell within 2 months of their ASD match. Unintentionally, both groups also demonstrated similar receptive language and expressive language abilities. None of the TD children had medical/developmental diagnoses, nor did they have an immediate family history of ASD. Six additional children with ASD were excluded from the final sample due to their chronological and/or mental ages exceeding the upper limit of the selected age range (n = 4) and failure to confirm ASD diagnosis using the ADOS (n = 2). No TD children were excluded. All participants came from a small city in southeastern Ontario and spoke English as their primary language.

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years (e.g., Kleinman et al., 2008) and that the ADOS is not effective at differentiating between diagnoses on the autism spectrum (e.g., McConachie,et al., 2005), we elected to include a children with a diagnosis anywhere on the autism spectrum. According to ADOS scores obtained in the lab, 8 children with ASD exceeded the cut-off for Autism, and the remaining 6 children met only the ASD cut-off score.

Table 1

Participant Sample Information

	ASD		TD		
	Mean (*SD*)	Range	Mean (*SD*)	Range	Significance, Effect size
Chronological Age	46.36 (11.33)	28 - 68	34.64 (17.40)	17 - 69	$p = 0.05$, $\eta p^2 = .15$
Nonverbal Mental Age	39.43 (12.86)	20 - 60	39.14 (13.63)	19 - 60	$p = 0.96$, $\eta p^2 = .00$
Expressive Language Age-Equivalent	32.85 (13.75)	12 - 60	35.85 (16.27)	14 - 60	$p = 0.62$, $\eta p^2 = .01$
Receptive Language Age-Equivalent	35.38 (13.05)	14 - 55	39.29 (13.91)	19 - 69	$p = 0.46$, $\eta p^2 = .02$
Gender	14 males		11 males, 3 females		
Autism Severity	13.71 (3.45)	8 - 18	N/A		

Note. All ages are represented in months; Nonverbal Mental Age = MSEL Visual Reception Age-Equivalent; Autism severity based on ADOS scores [Autism cut-off minimum score of 12 (Module 1 and 2), Autism Spectrum Disorder cut-off minimum score of 8 (Module 2) or 7 (Module 1)].

Measures

Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2002). The ADOS is a standardized tool used to evaluate and diagnose children on the autism spectrum. All participants with ASD participated either in Module 1 or 2 of this test to confirm their existing diagnoses. As previously indicated, two children did not meet the cut off criteria for an ASD in the ADOS administration (despite existing diagnoses), and thus were excluded from the final sample.

Mullen Scales of Early Learning (MSEL; Mullen, 2005). The MSEL is a standardized test used to evaluate the overall development (language, motor, visual abilities) of children from birth through age 69 months and whose use is common in the ASD literature. Given that the tasks included in the present study were largely nonverbal, age-equivalent scores on the visual reception domain (an indicator of nonverbal IQ) were used to individually match participants from each group on mental age. That said, all children also completed the language subscales of the MSEL and there were no significant differences in language abilities across groups.

Procedure and Design

To examine the prosocial tendencies of children with and without ASD, all participants engaged in a play-based session that evaluated three types of prosocial behaviour (*helping, sharing, and comforting*). This allowed for the session to have the appearance of a naturalistic social interaction with the experimenter and allowed for the prosocial tasks to occur relatively infrequently compared to the other activities. Caregivers who opted to remain in the room were instructed not to interfere with, or influence their child's response.

In total, children were presented with six prosocial trials (two helping, two sharing, and two comforting), which replicated the methodology used by Dunfield et al. (2011). Half of the prosocial trials were experimental (the experimenter demonstrated need) and half were control trials (no need was demonstrated).[12] The experimental and control trials were closely matched on perceptual characteristics to ensure that the children were responding specifically to the experimenter's need, as opposed to some other general task characteristic. The control trial for a specific prosocial task never immediately followed, or preceded, the corresponding experimental trial. The order of presentation of experimental and control prosocial trials was counterbalanced, such that half of the time the experimental trial was seen before its respective control trial, and vice versa. In all experimental prosocial trials, the experimenter never verbally requested aid. The conservative number of prosocial trials was selected intentionally for the purpose of mimicking real life frequencies of the need to engage in prosocial behaviour. Moreover, the authors sought to reduce the potential for an inflation of prosocial behaviour as a result of learning from exposure to multiple trials requiring the production of similar behaviour.

Prosocial behaviour. In the *helping* experimental trial, the experimenter walked a toy across the table and dropped it over the edge of the table closest to the child, said "Oops!", and unsuccessfully reached for the toy with an outstretched arm and hand. After dropping the toy, the experimenter looked only at the toy and then alternated her gaze between the toy and the child. In the control trial, the experimenter walked the toy across the table, placed the toy on the floor, and said "There". She folded her arms on the

[12] Two children did not receive all prosocial trials due to their disengagement from the testing. To account for these missed trials, percentage scores were calculated for each behaviour for the purpose of analyses.

table and looked neutrally in the direction of the child. In both trials, children were scored on the target behaviour, which consisted of retrieving the toy from the floor and giving it to the experimenter. Non-target behaviors were ignoring the toy, playing with it, or explicitly refusing to help the experimenter. Target and non-target behaviours across all prosocial trials are depicted in Table 2.

Sharing behaviour was tested when a research assistant brought in two plastic dishes containing crackers. In the experimental trial, the experimenter received an empty dish, drew the child's attention to its lack of contents ("Look what I have"), and then the child received his/her dish containing four crackers. The experimenter frowned and placed her hand out, palm upwards. Initially, the experimenter looked down at her hand, and then alternated gaze between her hand and the child. In the control trial, the experimenter and the child received two crackers each. Again, the experimenter received her dish first and drew the child's attention to her dish ("Look what I have") before the child received his/her own snack. The experimenter ate her crackers and looked at the child with a neutral expression. Children were examined for target (i.e., giving a cracker to the experimenter) and non-target behaviors (i.e., ignoring the experimenter, eating all the crackers at once, taking the crackers away from the table, or indicating "No").

Finally, to evaluate children's *comforting* behaviour, in the experimental trial, the experimenter bumped her knee on the edge of the table, sat on the floor with a look of distress on her face, and rubbed her knee while vocalizing pain ("Oh! My knee, I banged my knee"). Initially, the experimenter looked only at her bumped knee, and then alternated her gaze between her knee and the child. In the control trial, the experimenter again hit her knee on the table, but rather than indicating pain, she sat on the floor and

looked at the child with a neutral expression. To account for the wide variety of comforting responses, in both the experimental and control comfort trial, children were evaluated for their engagement in approach comforting behaviour (i.e., walks over to the experimenter to see if she is alright, kisses experimenter's knee) and non-approach comforting behaviour (i.e., vocalizing concern for the experimenter from a distance, providing instructions for help, directing the caregiver's attention toward the experimenter to help her). Importantly, for instances of both approach and non-approach behaviour, only behaviour aimed at alleviating the distress of the experimenter were considered 'comforting'. Vocalizations and approaches that did not serve to provide comfort were coded as non-target behaviour. Other non-target behaviors included approaching the caregiver without drawing attention to the experimenter (e.g., self-soothing), ignoring or failing to respond to the experimenter at all, and actively refusing to assist her.

Participation involved two visits for children with ASD and, in general, one visit for TD children, with each session lasting approximately 45 minutes. Four TD children required two visits due to their involvement in an additional study; these children engaged in the experimental task during the first visit and the MSEL during the other. The remaining TD children completed the experimental procedure, followed by the MSEL in a single visit. Nine of the children with ASD also participated in an additional study. Most children with ASD (n = 9) completed the experimental procedure and the MSEL in one visit and the ADOS in the other. On average, the timeline between children's first and second visits was three weeks (M = 21.88 days, SD = 26.92).[13]

[13] There was no suspected impact of a second visit on prosocial performance, as the experimental task was performed during the first visit in all but a small number of cases.

Table 2

Target and Non-Target Prosocial Behaviour

	Target Behaviour	Non-Target Behaviour
Helping	retrieve toy from floor and give to EXP	ignore toy
		play with toy
		explicit refusal to help EXP
Sharing	give/offer cracker to EXP	ignore EXP
		eat all crackers at once
		take crackers away from table
		explicit refusal to share with EXP
Comforting	approach response:	vocalize without intent to provide comfort
	walk over to EXP to see if alright	approach EXP without intent to provide comfort (e.g., walks past)
	kiss experimenter's knee	approach caregiver without attending to EXP (e.g., self-soothing)
		ignore experimenter/fail to respond to EXP at all
	non-approach response:	explicit refusal to assist EXP
	vocalize concern for EXP	
	provide instructions for help	
	direct caregiver's attention to EXP	

Note. EXP = experimenter

Coding and Data Analysis

Each session was coded by a research assistant who was blind to the purpose and hypotheses of the study. The prosocial trials (experimental and control) were coded based on the criteria previously described. The research assistant also recorded various time measures to capture the trial length and the response time for each participant on each measure. A second blind coder coded a subset of the videos (10 videos, 35%) to establish inter-rater reliability. Inter-rater agreement was very high across all prosocial tasks (Helping: Experimental $\kappa = 1.00$, Control $\kappa = 1.00$; Comforting: Experimental $\kappa = .86$, Control $\kappa = 1.00$; Sharing: Experimental $\kappa = 1.00$, Control $\kappa = 1.00$).

Non-parametric analyses were conducted to evaluate children's performance across all experimental tasks given that these tasks yielded ordinal or nominal data. Scores on the prosocial trials were converted into binomial scores which defined engagement in either target or non-target behaviour. To account for the small group of children who missed a prosocial trial, percentage scores were calculated (see Footnote 12).

Results

Alpha was set at .05 in all analyses. There was no effect of order of the presentation of the individual tasks (Fs < 2.21, ps > .12, η_p^2s < .28) on any of the prosocial trials in the ASD and TD group. Thus, all subsequent analyses were collapsed across order.

Prosocial Behavior

Group comparisons. Mann Whitney *U* tests were used to evaluate group differences in performance on prosocial tasks. Children with ASD were equally as likely

to provide assistance to an experimenter who could not reach a fallen toy (helping experimental trial) and to comfort a hurt experimenter (comfort experimental trial) as their TD counterparts. A group difference was found in one of the measures of prosocial behaviour, namely children with ASD showed significantly less sharing behaviour on experimental trials as compared to TD children (Table 3).

Table 3

Means, Standard Deviations, and Mann Whitney U Tests for Main Measures as a Function of Group

	Group		
	ASD	TD	
Prosocial Experimental trials	*M (SD)*	*M (SD)*	Mann Whitney U
Helping	21.43 (42.58)	50.00 (51.89)	$Z = -1.55, p = .12$
Sharing	33.33 (49.24)	78.57 (42.58)	$Z = -2.28, p = .02$
Comforting	57.14 (51.36)	35.70 (49.70)	$Z = -1.12, p = .26$

Note. Means represent percentage of children who performed target behaviour

As a means of better understanding *how* children provided comfort, given the variety of possible comforting responses, the following breakdown was determined: In the ASD group, 7.10% ($n = 1$) of children did nothing, 28.60% ($n = 4$) stared at the experimenter, 7.10% ($n = 1$) engaged in self-soothing, 42.90% ($n = 6$) provided a non-approach response (e.g., "Do you need a Band-Aid?", "Are you ok?"), and 14.30% ($n = 2$) provided an approach response (e.g., walk over to see if ok, kiss on the knee). In the TD group, 50.00% ($n = 7$) stared at the experimenter, 14.30% ($n = 2$) engaged in self-

soothing, and 35.70% (n = 5) provided a non-approach response. Thus, most children who offered comfort to the experimenter did so verbally, from a distance, rather than approaching the experimenter to provide physical comfort.

Experimental versus control trials. Irrespective of group differences in the amount of helping, sharing, and comforting behaviour observed, of importance is whether children distinguished between situations that warranted a prosocial response from those that did not. A series of Wilcoxon Signed Rank tests were conducted to evaluate within-group differences across experimental and control prosocial trials. Both groups were significantly more likely to engage in prosocial behaviour during the experimental prosocial trials versus control prosocial trials, in all but one case (Table 4). That is, children with ASD did not differ in their performance across the experimental and control helping trials, likely due to their low levels of helping behaviour in general. No children in either group engaged in either helping or sharing behaviour when the need was absent (control trials). Only one child from each group exhibited comforting behaviour in the comforting control trial and in both cases, the response was a verbal inquiry as to why the experimenter was sitting on the floor (e.g., "Oh! What happened?").

Response latency and trial length. Analysis of the length of prosocial trials is essential to ensure that the prevalence of prosocial behaviour observed was not restricted by the time parameters employed in the present study. Regardless of the nature of children's response (target and non-target behaviour) on prosocial trials, the response latency for those who responded in some manner was fast and did not differ across groups (Zs < -1.75, ps > .08). Across both groups, children responded within an average of 6.25 seconds (SD = 6.47) of the experimenter exhibiting need (or lack thereof) in all

experimental and control prosocial trials. Children with and without ASD who did not respond in any way were given substantially more time (M = 87.79 seconds, SD = 94.82) than was needed by those who did respond, to execute target and non-target behaviour.[14]

Table 4

Means, Standard Deviations, and Wilcoxon Signed Rank Tests for Within Group Comparisons on Experimental and Control Trials

		Trial		
		Experimental	*Control*	
Group	*Prosocial behaviour*	*M (SD)*	*M (SD)*	Wilcoxon Signed Rank
ASD	Helping	.21 (.43)	0.00 (0.00)	Z = -1.73, p = .08
	Sharing	.33 (.49)	0.00 (0.00)	Z = -2.00, p = .05
	Comforting	.57 (.52)	.08 (.28)	Z = -2.65, p = .008
TD	Helping	.50 (.52)	0.00 (0.00)	Z = -2.65, p = .008
	Sharing	.79 (.43)	0.00 (0.00)	Z = -3.32, p = .001
	Comforting	.36 (.50)	.07 (.27)	Z = -2.00, p = .05

Note. Means reflect binomial scores

Correlations

Spearman correlations were calculated to explore associations between nonverbal mental age and performance on the prosocial trials. In children with ASD, nonverbal

[14] A group difference in the trial length for children who did not respond was found only on the comforting control trial (Z = -2.27, p = .02), with the ASD group receiving a shorter amount of time than the TD group. This was due to the need of the experimenter to move quickly onto the next activity with children with ASD, so as maintain their engagement in the task.

mental age was significantly positively associated with helping and sharing behaviour (r = .65, p = .01; r = .80, p = .002, respectively), where as in TD children, nonverbal mental age was significantly positively associated with only sharing behaviour (r = .58, p = .03).

Discussion

The goal of the present study was to explore the prosocial tendencies of young children with ASD on specific forms of prosocial behaviour that involved different kinds of need exhibited by the experimenter. We found that, despite well-documented social cognitive impairments, young children with ASD are able and willing to respond to some forms of need required by an experimenter. Specifically, the findings suggest that young children with ASD provided comfort (verbal and physical) to a hurt experimenter and did so at a level consistent with their TD peers of equal developmental level. Moreover, children with ASD demonstrated some appropriate sharing of resources, albeit less than observed in TD children. Importantly, in both comforting and sharing, children with ASD successfully discerned situations where a need was warranted from when it was not and adjusted their behaviour accordingly; despite the perceptual similarity of all prosocial control trials to their respective experimental trials, children with ASD did not provide assistance unless there was an indication of need by the experimenter. These findings support and expand existing research by demonstrating that despite marked social impairments, children with ASD *do* act prosocially and can do so in situations that extend beyond helping and cooperating (Liebal et al., 2008). Additionally, like Dunfield et al. (2011; Dunfield & Kuhlmeier, in press), the results of the present study support the proposal that different types of prosocial acts are best understood as unique behaviors rather than elements of a homeogenous family of actions. In the present study, the

amount of the prosocial behaviour displayed varied depending upon the kind of need that the experimenter required.

Helping

Children with ASD in the present study provided low levels of instrumental aid to an experimenter, with less than a quarter of children actually retrieving the out-of-reach toy for the experimenter in the helping task. In fact, they performed as though no need was exhibited by the experimenter at all. Our overall rate of helping in response to need (experimental trials) is approximately half that seen in Liebal and colleagues (2008). That said, the number of children who helped exclusively in experimental trials in each study was comparable (about 20% of children with ASD in both cases). That we found no difference across experimental and control trials contrasts with Liebal et al., but is likely accounted for by the low frequency of helping behaviour by children with ASD in the present study. Two key methodological differences in procedure may account for the lower levels of helping behaviour seen in our sample as compared to Liebal et al. First, we included only one experimental and one control helping trial, in contrast to their use of two of each. Thus, children in the Liebal et al. study had twice as many opportunities to demonstrate helping behaviour and were possibly able to learn from previous trials, which all involved retrieving and handing something to the experimenter. Second, the behaviour displayed by the ASD group in the present study suggests that our choice of stimuli may have reduced their likelihood of helping. Specifically, the provision of instrumental help appeared to come at a cost to the child, as it involved the release of a desired resource: the toy. Fifty-five percent of the children with ASD who did not provide help actually retrieved the toy, but played with it themselves rather than giving it

to the experimenter. In contrast, the target objects used by Liebal et al. were potentially uninteresting to the child (e.g., clothespin, pen) and therefore possibly easier to part with.

Sharing

To our knowledge, the present study is the first to experimentally evaluate (i.e., by including a control trial) preschoolers with ASD for their propensity to recognize a social partner's lack of material need and then act to alleviate that need by sharing some of their own material resources. While Travis et al. (2001) also measured sharing behaviour, a direct comparison is not permitted given the older age of their participants and the fact that instead of reporting a separate sharing score, the authors derived a combined helping and sharing prosocial score. In the present study, although sharing was observed in only approximately one third of the ASD group, and to a lesser extent than the TD group, their performance is noteworthy nonetheless. Children with ASD shared their snack when there was an inequality of resources between themselves and the experimenter but not when both parties had equal portions, likely marking at least some recognition of the experimenter's material need in the former.

It remains unclear as to *how* children determined that a need was present, given that they had situational cues (unequal snack portions), bodily gestures (outstretched hand), and a facial expression (sad face) at their disposal. One can speculate that known deficits in affect regulation in the ASD population rendered the facial expression least informative (e.g., Dyck et al., 2001), thus, incorporating a sad face into the control condition is unlikely to have increased the incidence of sharing. Despite their challenges in their understanding of nonverbal cues (Dyck et al.), it is possible that the outstretched hand may have been a sufficiently clear indicator of need for some children and may have

increased sharing behaviour in the control condition, despite equal snack portions. Regardless, it appears that children with ASD were able to extract something from the situation that indicated a need by the experimenter and was this sufficient for a portion of children with ASD to choose to share their snack only in the experimental condition. Moreover, those who shared did so even though it came at a cost to them. Unfortunately, the parameters of our study do not permit us to objectively comment on the absence of sharing in the remaining children with ASD, which may relate to obstacles in need-detection, a motivational component, or the capacity to produce sharing behaviour. It is important again to emphasize that the present measure of sharing captures only a sharing of resources and does not speak to other intangible forms of sharing (e.g., sharing of information).

Comforting

In contrast to their helping and sharing performance, children with ASD more readily offered support to an experimenter who had bumped her knee and who displayed an emotional need, in contrast to when that need was absent. In fact, about 65% of children with ASD comforted the experimenter, either verbally from a distance (42.90%) or physically (14.30%), and were as likely to do so as their TD peers of equal developmental level. Despite the absence of comparative research on comforting in young children with ASD, these findings were unexpected in light of existing ASD empathy literature, in which children and adults alike tend to be poor at identifying other's emotional states and have demonstrated reduced empathic tendencies in some studies (e.g., Baron-Cohen & Wheelwright, 2004; Dyck et al., 2001; Hobson et al., 2009; Yirmiya et al., 1992). In fact, Minio-Paluello, Baron-Cohen, Avenanti, Walsh, and

Aglioti (2008) suggest that impaired empathic responding in individuals with ASD can even be linked to basic levels of neural processing.

A counterintuitive, yet plausible, explanation is that having a reduced empathic response may have actually benefitted children with ASD in the current study. That is, children with ASD did not appear to treat the comforting trial as an emotionally-laden task. The comforting behaviour exhibited by children with ASD was largely instrumentally-oriented (e.g., kissing the experimenter on the knee, asking if the experimenter needed a Band-Aid, providing direction) and lacked signs of personal distress. This finding is noteworthy, given that in typical development the provision of instrumental help is observed sooner in development than the provision of empathic helping (Svetlova, Nichols, & Brownell, 2010). Also, the automaticity of the responses of children with ASD in the current study suggests that these children had good knowledge, or scripts, of what to do when someone is hurt, which were activated once the need for comfort was detected. This behaviour differed drastically from the TD children who were more reserved in their provision of comfort (they *never* directly approached the hurt experimenter) and who tended to defer to their caregiver. When these children did provide comfort it came in the form of distal reassurance ("That's ok").

Taken together, the experience of witnessing the experimenter hurt herself and determining an appropriate course of action may have been less emotionally-taxing to children with ASD than TD children (for more discussion of the emotional cost of comforting see Hoffman, 1982; 2000), given that the former are less apt to perceive and empathize with another's distress. Children with ASD may have perceived the comforting task as relatively 'cost-free' as there was nothing tangible to give to the

experimenter to alleviate her need. In contrast, TD children may have experienced a more intense empathic response to the experimenter, leaving them more prone to personal distress (i.e., anxiety or discomfort) based on the recognition of the experimenter's emotional state or condition (e.g., Eisenberg et al., 1991).

Beyond the 'matter-of-fact' comforting style of the ASD children, we suspect that the parameters of the comforting task facilitated their detection of the experimenter's need. Despite the speed at which the appraisal of a person's need can take place (children who responded in the present study did so under 6 seconds on average), multiple factors can add to the complexity of this task, including the complexity of the need (instrumental, material, emotional) (e.g., Svetlova et al., 2010) and especially the number of cues that are at children's disposal (verbal, nonverbal, situational). The comforting paradigm used in the present study offered children a clear verbal cue as to what had happened to the experimenter ("Oh! My knee. I banged my knee!"). While the need itself was not verbalized, this verbal marker increased the saliency of the fact that the experimenter was hurt. Verbalizations were made during the helping ("Oops") and sharing ("Look what I have") trials, but they were vague and did not directly say what was 'wrong', leaving children to rely on the nonverbal cues offered by the experimenter instead. Given that children with ASD are challenged in their understanding of nonverbal cues (Dyck et al., 2001), they may have been disadvantaged at detecting the experimenter's need in the helping and sharing trials. The success of children with ASD on the comforting task may then be associated with the increased saliency of the experimenter's need (through a clear verbal cue) which aided in their extraction of pertinent information about the situation, and potentially activated a repertoire of scripted comforting responses. Note that from

this stance, knowing how to comfort the experimenter may not have been achieved through a true comprehension of the complex emotional need associated with being hurt, but through children's previous experience of what one must do when a person indicates that they are hurt.

Limitations and Future Directions

While the present study marks advancement in understanding the prosocial tendencies of young children with ASD, it represents only the beginning stages of a movement towards properly appreciating what forms of prosocial behaviour children with ASD will engage in, what cues are necessary to detect a social partner's need, and what pre-requisites are needed to enable engagement in the behaviour. Most likely, the constellation of results obtained in the present study suggests that a myriad of factors are implicated in the propensity of children with and without ASD to act prosocially. While we highlight the 'costs' of prosocial engagement and the associated role of motivation, other factors including social cognition, perspective taking, affect and emotion recognition, attention, behaviour regulation, motor planning, among others, will certainly contribute to children's ability to detect another person's mental states and facilitate their ability to act on the person's behalf (e.g., Colombi et al., 2009; Travis et al., 2001). Even so, it appears possible that certain variables may provide a buffer when these skills are impaired. In both groups, nonverbal mental age was significantly positively associated with at least one form of prosocial behaviour, suggesting that a child's general ability to organize and reason about what they see (interpret what is happening in their environment) appears to promote prosocial success. Moreover, the more salient the markers of need (or cues) the better children with ASD appear able to detect what it is

that they must do. When the cues indicating need were clearly presented (e.g., verbal cue), the prosocial tendencies of children with ASD improved. Each of these also raises the strong likelihood that severity of ASD diagnosis will impact this population's prosocial tendencies.

The limitations in the current study are worthy of consideration and highlight areas that may be addressed in future research. First, the artificial lab environment helped to direct children's attention to the experimenter's bid for help, which limits the generalizability of our findings to everyday unstructured environments where distractions are plentiful. Moreover, the challenges in recruiting young children already diagnosed with ASD required the inclusion of a relatively broad age range of participants, as well as children diagnosed anywhere on the spectrum. A more restricted age range and restricted diagnostic criteria (e.g., only Autism) would permit for more specific investigations of engagement in prosocial behaviour. We also highlight that knowing how to act on another's behalf, does not necessarily equate *understanding* that person's need. Instead, having a repertoire of learned behaviors, or scripts, to draw upon when prosocial behaviour is warranted may be sufficient. Likewise, the absence of prosocial behaviour in some of our participants must not be interpreted as a lack of understanding about what to do, as multiple factors that were not measured here may have inhibited children's ability to *demonstrate* and *communicate* their understanding (e.g., motivation, use of gestures, motor planning, etc.). It is possible that some children in our sample have undergone intervention which may have facilitated their demonstration of prosocial behaviour.

In conclusion, we demonstrate that young children with ASD are able to distinguish situations where need is warranted from when it is not and appear to be able to tap into pertinent knowledge about a person's intentions and needs. Although this study did not directly examine levels of cost and motivation associated with engaging prosocially, the pattern of results obtained here suggest that when the instrumental cost of engaging in prosocial behaviour is high, children with ASD may be less inclined to engage in the behaviour. Thus, both the capacity to recognize another's need *and* the drive to act on behalf of another appear to play important roles in the production of prosocial behaviour. Other variables, including mental age, the saliency of the indicators, and learned behaviors may also be linked to the prosocial performance in children with ASD and require further exploration. Future investigation is needed to systematically delineate the individual and environmental correlates of prosocial behaviour in this population.

Chapter 4 - General Discussion

Social impairments in children with ASD were once characterized as both 'severe and persistent' (Howlin, 1986). The current set of studies adds to the growing body of literature that demonstrates that the social deficits in children with ASD are not all-encompassing and that some domains of social functioning may remain intact. In Study 1, preschoolers with ASD displayed similar levels of imitation to TD preschoolers when successful performance resulted in an external reward. In Study 2, young children with ASD struggled on tasks of helping and sharing, but were equally as likely as TD children to comfort a hurt adult. While both studies addressed relatively novel questions that require ongoing exploration, they highlight the notion that children with ASD may require a different set of 'conditions' to engage in social behaviours at the same level as their TD peers. We discuss these 'conditions' in turn and incorporate their implications on the competing theoretical explanations.

Incentive to Engage

One 'condition' that appears necessary for at least one form of social behaviour is a strong incentive for engagement. The importance of motivation on participation is demonstrated in Study 1, drawing attention to both internally- and externally-driven factors. The pattern of results in this study suggests that unlike TD children, the social rewards inherent in imitating another person's actions on objects may be insufficiently motivating for young children with ASD. This finding is in keeping with previous imitation studies that find children with ASD to be less attentive to other social elements of the task (Hobson & Hobson, 2008). In contrast, children with ASD appear to benefit

significantly (in spite of our relatively small sample) from the incentive of an external reward.

In line with Rogers et al. (2003), we also suggest that children with ASD may be internally motivated to acquire knowledge about how objects work, hence their preserved performance on goal-based imitation tasks (Aldridge et al., 2000). Possibly, external rewards offered in our tasks were not only motivating themselves, but also alerted children to whether they had learned correctly from the experimenter. In natural imitation contexts, children with ASD may be less able to evaluate their performance given their decreased tendency to orient to social information (Riby & Hancock, 2008), as well as challenges in interpreting social cues (Dyck et al., 2001), which may contribute to their reduced motivation to imitate under these circumstances. This interpretation compliments the Social Motivation theory that incorporates both elements of impaired social orienting (inability to evaluate performance using socially available information) and impaired tendency to seek and find pleasure in social interaction (requirement of external reward for successful performance).

This study, paired with the findings of Ingersoll and colleagues (2003) offers preliminary, but direct, support for the Social Motivation theory which posits that impairments in social cognition are secondary to an innate deficit in social motivation (Chevallier et al., 2012). Chevallier and colleagues proposed that under the Social Motivation theory increases in social attention ought to bring about increases in social cognition. The fact that imitation performance increased immediately with an incentive, without teaching, suggests that the underlying ability to imitate was already present (and not innately deficient as the Social Cognition theory would suggest). In isolation, these

studies cannot sufficiently rule out the Social Cognition theory, nor do they rule out motor and cognitive factors as contributing to such a deficit (e.g., Smith & Bryson, 1997; Williams et al., 2001). Instead, this study calls for future research that is equipped to tease apart impairment from motivation and that address this question across all types of imitation.

Conclusions surrounding whether children with ASD are averse to social interaction (rather than simply uninterested) cannot be drawn from Study 1. However, Study 2 offers an indirect and unique perspective of motivation, particularly surrounding the cost of engaging socially. Children with ASD displayed lower levels of helping than previously observed (Liebel et al., 2008), which was suspected to relate to the perceived cost of relinquishing a desired object, thus decreased motivation to perform the target behaviour. Conversely, higher than expected levels of comforting behaviour were thought to relate to a reduced perception of emotional cost for children with ASD, who lacked signs of personal distress.

A further prediction under the Social Motivation theory is that social cognitive deficits might only appear in a subgroup of children with ASD, whereas a social motivation deficit would be apparent in most (Chevallier et al., 2012). Study 2 demonstrates that there was some element of situations where an adult needed assistance that motivated children to act, but not where this need was absent. At first glance, this finding contradicts the Social Motivation theory that would predict impairments in seeking interaction and impairments in fostering social relationships. However, with closer examination of the tasks on which greater prosocial behaviour was observed (e.g., comforting) it is less clear if children with ASD sought to alleviate the other's need, or if

children were prescribing to a learned script. In this view, the social interaction itself may not have been the root of children's motivation to engage. Likewise, we cannot provide confirmation for preserved social cognitive understanding, as levels of social cognitive functioning were not measured in Study 2. We urge extreme caution in interpreting the findings from Study 2 as supporting or contradicting either theoretical account, as these ideas were not tested directly. Instead, this study paves the foundation for future investigations of prosocial behaviour that entail manipulations of cost and inclusion of measures of motivation and social cognition.

Clarity of Expectations

A second 'condition' that appears to facilitate social engagement in young children with ASD is clarity of task expectations. As previously discussed, a clear reward and clear goals contributed to increased amounts of procedural imitation in Study 1. In Study 2 this point is exemplified in that performance was greatest on the task in which there was less ambiguity as to what response the situation called for. It is suspected that the clear verbal cue during the comforting task alerted children with ASD to the need of the experimenter, thus minimizing the need for reliance on nonverbal and situational cues to determine how to respond. Moreover, this cue appeared to trigger learned responses regarding how one helps a person who is hurt. Thus, the more concrete the expectations, the more easily children with ASD were able to ascribe to previous knowledge and the less they were required to rely on social interpretation. Even more, children's ability to organize and reason about what they see (nonverbal thinking abilities) was associated with at least one form of prosocial behaviour. Given that each form of prosocial behaviour entailed different demands and are thought best to be treated

as separate entities (Dunfield et al., 2011), future research should examine prosocial behaviour with systematic manipulations of cues to directly test the role of clear expectations. Nonetheless, similar interpretations regarding task expectations have been made in the imitation literature (Ingersoll, 2008; McDuffie et al., 2007).

We cautiously consider the implications of this 'condition' on the theoretical underpinnings of social cognitive deficits in children with ASD, as clarity of task expectations was not directly manipulated. Yet, the factors observed to enhance their performance, appear to best tie into the issue of how well children are able to orient to, and appropriately select, social information in their environment. While decreased social orienting is a component of each the Social Cognition and the Social Motivation theory, and does not assist in disentangling the two, it provides insight into how deficits in social orientation may be remedied.

Clinical Implications

The current set of studies provides some preliminary support for the Social Motivation theory of social cognitive deficits in children with ASD. With further studies supporting these ideas, intervention and training programs ought to aim to increase motivation to engage socially rather than to teach social cognitive skills that could already be within the child's repertoire of abilities, simply not being used. Importantly, the present studies demonstrate that motivation need not only come in the form of tangible or monetary rewards, but that learning and accomplishment of goals may be equally valuable. The current studies also demonstrate that irrespective of the underlying mechanisms, training programs that incorporate the building in of environmental supports to assist children with ASD at detecting necessary social information, as well as social

scripts to reduce reliance on interpreting social needs of others, will be most successful at facilitating social behaviour.

In sum, we alert readers to the care that must be taken in future research in evaluating social behaviour in this population, who may be capable but uninterested in performing the tasks which we seek to measure. Continued examination of young children with ASD is required to both assist in disentangling theoretical explanations and offsetting the resulting sequelae on social and cognitive behaviour. Increased understanding of the nature of the core deficits in social functioning will inform training programs that may currently be targeting the wrong mechanism. We discourage attempts at searching for a unitary explanation for social impairments in this population and suggest that the reason for observed deficits may be as heterogeneous as the ASD population itself. Continued investigation of which factors account for the most weight across different kinds of tasks will be most informative. Finally, social cognition plays a vital role in both social and cognitive development, thus, ongoing research of this domain and understanding its impact on the development of children with ASD is needed. Along with this, research should continue to explore those factors that facilitate social functioning when difficulty at detecting social cues is apparent.

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